Gunners' Instruction

(Thirteenth Edition)

MINE COMPANIES

1916-1917

Journal U. S. Artillery, Fort Monroe, Virginia, 1916

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(Mine Companies)

------ Company, Fort ----------

Again this year, the JOURNAL, without mentioning them by name, expresses its grateful appreciation to the officers and men of the Corps and of the School who have rendered it valuable assistance in the preparation of text and illustrations for "Gunner's Instruction."

As in the past, the JOURNAL will appreciate having brought to its attention suggestions looking to the perfecting of the pamphlet.

"Gunners' Instruction" is issued in separate pamphlets for Mines, for Mortars, and for Guns.

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Page 17, top of page: (e) should be (d).
" 19, first line, third word: lock should be block.
" 25, top of page: (f) should be (e).
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" 75, DEFINITIONS should be preceded by APPENDIX "B."

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Department of Enlisted Specialists, C. A. S.

U. S. ARMY MINE PLANTER GENERAL SAMUEL M. MILLS

SECOND CLASS GUNNERS

(a) AMMUNITION, NOMENCLATURE, Etc.

(See Supplement for 3-, 4-, and 4.7-inch Guns.)

(b) MATERIAL AND DUTIES OF THE LOADING ROOM

(Except electrical principles involved.)

Q. What tools and materials are used in making a telegraph joint?

A. A pair of pliers, navy knife, wire, and, if insulation is desired, rubber tape.

Q. How do you make a telegraph or twist joint?

A. The insulation is removed from the ends for one and a half inches and the wires brightened. The ends to be joined are placed across each other about one half inch from the insulation, making an angle of about 45° with each other. The wires are grasped firmly at the junction and each free end wound tightly around the other wire for four turns; the winding should be in opposite directions. The ends of the wires are trimmed down so they will be smooth and have no sharp points.

Q. How do you insulate a joint?

A. A piece of rubber tape about two inches long is cut with diagonal ends, the cuts being made in such a way that both acute angles, or points, are on the same edge of the tape, resulting in a long edge and a short edge.

Starting at a point about three fourths inch back on the insulation, with the long edge of the tape toward the joint, the tape is stretched and wound around the joint under tension, each turn covering the one under it about one third.

The wrapping covers the same amount of insulation at each end and is worked backward over the joint and secured by pressing it firmly or placing a drop of cement under it.

Be careful in wrapping to hold the wire firmly and prevent the joint from twisting.

Q. What tools and materials are used in making a water-tight joint?

A. A pair of pliers, navy knife, wire, rubber cement, rubber tape, protective tape, and tin foil. Cotton waste and kerosene, or a torch, is needed for vulcanizing.

Q. Explain how to make a water-tight joint.

A. The two ends of wire are scraped clean for about three-fourths of an inch and joined by a brass jointer, which is then crimped. The insulation is scraped clean about 2 inches on each side of the jointer and covered with rubber cement. Two strips of rubber tape are cut with diagonal ends about 6 inches long, and stretched. Beginning about 1½ inches along the insulation, the tape, with the long edge toward the joint, is wrapped firmly and tightly until about ¼ inch of the insulation on the other side is covered; it is wound back and forth over the joints so as to taper toward the ends. The other piece of tape is used, beginning at the other end and wrapped as before. The finished insulation should be thick at the middle, tapering toward the ends. It should be firm and tight. The insulation is covered with tin-foil, wrapped with protective tape and vulcanized. The protective tape and tin foil are then removed, the joint inspected, and new protective tape wrapped on, using two pieces, starting at opposite ends and finally ending each beyond the center.

Q. What tools and materials are used in making a Turk's-head?

A. A pair of pliers, navy knife, hammer, Turk's-head collar, marline, and cable.

Q. Explain how to make a Turk's-head.

A. The cable is trimmed square and a wrapping of four or five turns of marline is made about 15 inches from the end. The collar, flat side first, is slipped on until it rests on the marline; the iron wires are bent back regularly over the collar. The jute wrapping is unwound to the collar and trimmed, and all the iron wires are cut with the pliers, removing all but four inches and 6 inches from alternate strands; the iron wires are bent separately to fit the collar closely, and the ends arranged smoothly along the cable; the end of a piece of marline is caught under one of the wires near the collar and wrapped regularly and closely around the cable, and the free end of marline secured with two half hitches. About 15 feet of marline are required for single conductor cable; 24 feet for multiple cable.

Q. How is a transformer tested and prepared for service?

A. With a voltmeter and dry cells it is tested for:

1. Good circuit between red wires.
2. Poor circuit through black wire.
3. Good circuit between lower end of black wire and center stud in neck of transformer.
4. No circuit between black and red wires.
5. No circuit between any wire and the case.

The upper end of black wire is then bared for about one-half inch and secured in the binding post in neck of transformer.

The ball seat is screwed home. The spring plate, distance ring, and ball are placed in the circuit closer cap, which is held upside down while the transformer is screwed into it. In service the threads are coated with "ruberine."

Q. Name the parts of a compound plug. (See page 5.)

A. *Old model, brass fuse can.*—
Circuit closer.
Mine transformer.
Fuse can.
Fuse can cap.
Lower tube.
Plug, proper.
Two brass glands and followers.
Four lead washers.
Two rubber packings.

Rubber fuse can.—
Circuit closer.
Mine transformer.
Brass collar.
Connecting collar.
Rubber fuse can.
Fuse can cap.
Plug, proper.
Connecting bolts.
Two followers.
Lead washer.
Two rubber packings.
Brass gland; brass washer; and followers.

Trotol fuse can.—
Circuit closer.
Mine transformer.
Brass collar.
Connecting collar.
Brass fuse can.

Fuse can cap.
Plug, proper.
Connecting bolts.
Brass washer.
Lead washer.
Rubber packings and followers.
Brass gland.

Q. How do you assemble a compound plug?

A. *Old model, brass fuse can.*—

Cut a piece of loading wire three feet long and bare the ends. Join one end to the lower black wire of the transformer by a telegraph joint and tape it. Draw this wire and the two red secondary wires through the fuse can and screw the can on the transformer, the threads of which have been covered with "ruberine."

Two service fuses, which have been tested, are joined with their leads in pairs, and the two terminals formed are connected to the two red terminals of the transformer, and the joints taped.

The can is then held vertically, with transformer down, and, if trotol is used, the fuses are placed in the can and the trotol poured in around the fuses and up to the screw threads; if dynamite is used, it is put in a cloth bag with the fuses and the bag is placed in the can.

The loading wire is drawn through a lead washer and the fuse can cap. The threads of the cap are covered with "ruberine" and screwed into place.

Now thread a rubber packing, brass gland, and follower with "ruberine" on its threads, over the loading wire and screw the follower into the cap with moderate pressure.

Put "ruberine" on the threads of the lower tube and screw it into place with a lead washer between it and the cap.

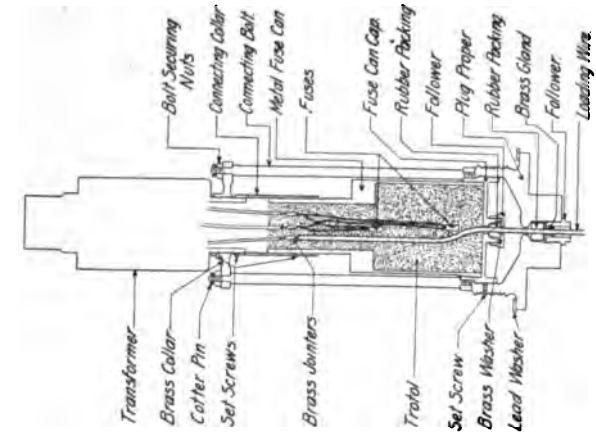
Draw the loading wire through a lead washer and the plug, proper, and screw the plug hard against the lower tube.

Thread another rubber packing, brass gland, and follower with "ruberine" on its threads, over the loading wire and screw the follower into the plug, proper, with moderate pressure.

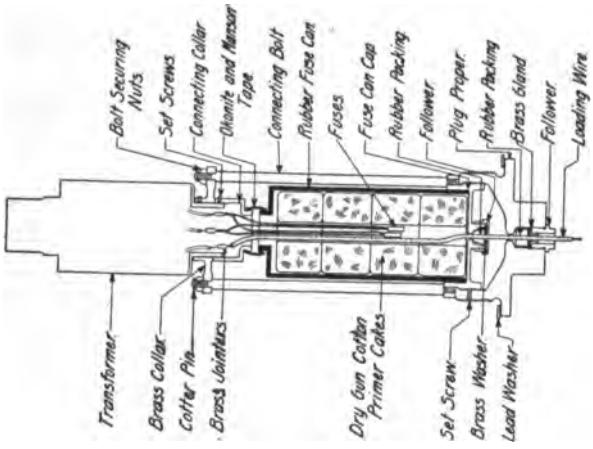
Rubber fuse can.—

Two service fuses, which have been tested, are cut with 9-inch leads, wires bared for 1 inch and connected in multiple.

Cut a piece of loading wire 3 feet long and bare the ends for a telegraph joint. Thread this wire through the hole in a primer cake of dry guncotton.

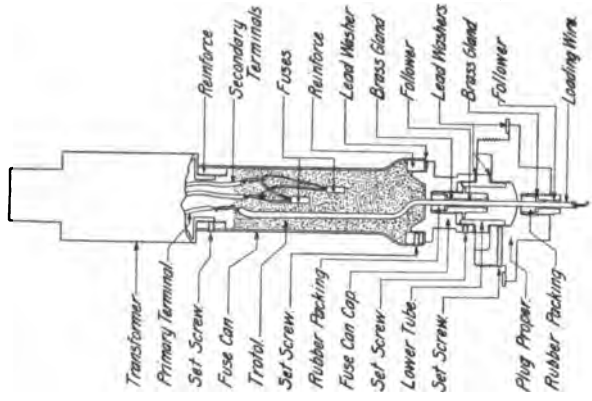


TROTOL FUSE CAN



RUBBER FUSE CAN

COMPOUND PLUG



OLD MODEL FUSE CAN

Place the two fuses in this hole and draw the loading wire up till it is the same length as the fuse leads.

Thread two primer cakes on the wire above this first cake and one below it.

Hold the four cakes in one hand, with the fuse leads upright, and slip the fuse can over the cakes, threading the fuse leads and loading wire through the top.

Put "ruberine" on the threads of the fuse-can cap and screw it on the fuse can.

Thread rubber packing, brass washer, and follower on the loading wire, and screw moderately into seat in the cap.

Hold the plug, proper, upright in a vise. Cover the threads of the fuse can cap with "ruberine," screw the assembled can into the plug, proper, and secure it with set-screw.

Handle the loading wire carefully when passing it through the plug, proper, and when screwing the fuse can in place.

Cut the three transformer leads about 6 inches long and bare the ends for one inch.

Screw the brass collar on the transformer. Slip the connecting collar over the fuse leads and loading wire and rest it on the fuse can.

Support the transformer by turning it upside down and hanging it on the ends of two connecting bolts passing through the holes in the collar.

Join the secondary (red) leads and the fuses, and the primary (black) lead and the loading wire, with brass jointers or telegraph joints. Smooth these joints with a file and wind with rubber tape.

Take the transformer off the connecting bolts and hold it right side up above the fuse can until the lead wires are extended; then lower it, coiling the leads in the base of the transformer. Put "ruberine" on threads of transformer and screw on the connecting collar and secure it with set screw.

Place brass collar on connecting bolts and secure with the nuts and cotter pins.

Put a thin coating of rubber cement on the lips of the fuse can and the connecting collar. Lay a piece of rubber tape, 18 inches long, around the opening without stretching.

The same length of protective tape is then laid over the rubber with considerable force.

Assemble on the loading wire the rubber packing, brass gland, and follower with "ruberine" on its threads, and screw into place in base of the plug, proper.

Take care not to pinch the insulation with too much force.

Trotol fuse can.—

Cut two tested service fuses with 12-inch leads, bare the ends for one inch and connect in multiple.

Cut a three foot length of loading wire and bare the ends for a telegraph joint.

Thread loading wire through fuse can and cap. Cover threads of can with "ruberine" and screw can into cap.

Cover threads of connecting collar with "ruberine" and screw it down against shoulder of can.

Thread rubber packing, brass gland, and follower with "ruberine" in its threads, over the loading wire and screw follower into the fuse can cap with moderate pressure.

Place the plug proper in a vise. Coat threads of fuse can cap with "ruberine" and screw it home into plug, proper, with spanner wrench.

Take care of loading wire when passing it through the hole in plug, proper, and when screwing the fuse can in place.

Put fuses in can and fill the can to the top with trotol.

Cut transformer leads to 4 inches and bare the ends for 1 inch.

Cover threads of brass collar with "ruberine" and screw it on transformer. Lower transformer on the connecting bolts and join secondary (red) leads with fuses, and primary (black) lead with loading wire by telegraph joints. Coil the leads and joints in base of transformer.

Screw connecting collar up against brass collar on transformer, first covering threads with "ruberine."

Place securing nuts and cotter pins.

Prepare stuffing box of plug, proper, in same way as was done with fuse can cap.

Q. How do you test an assembled compound plug?

A. With a voltmeter and the number of dry cells that will give a full scale reading on lower scale of the meter.

The voltmeter and cells are connected in series and the leads carried to the loading wire and case.

There should be a poor circuit with the plug vertical and a good circuit when plug is tipped over beyond 45 degrees.

Q. How is a mine loaded?

A. The mine case is placed on a loading skid with plug end up. Remove the plug, clean the screw threads and place a loading funnel in the hole.

The explosive is brought in, one box at a time, and placed

in the mine case by hand, leaving room for the compound plug. After the charge is in place, clean the threads with a button brush and coat them with "ruberine." Put "ruberine" on the threads of the compound plug and slip a lead washer over it to its seat on the plug, proper.

Hold the case against turning by putting a bar through holes in the skids and the maneuvering ring of the case.

Screw the compound plug home with a socket wrench and tap it to a tight fit with a wooden bar. Bolt the mine cap in place.

Q. How do you test a loaded mine?

A. Place it in the loading room tank for 24 hours and make same test as on compound plug with one lead to the loading wire and the other to the water or the case.

When taking mine case out after test, push loading wire inside the cap to protect it.

Q. What tools are used in preparing a compound plug?

A. Bench vise, "S" wrench, large monkey wrench, screwdriver, pliers, navy knife, file, scissors, Stilson wrench.

(c) MATERIAL AND DUTIES ON THE WATER

Q. How are mines numbered?

A. Facing outward, groups are numbered from left to right, and from front to rear. The mines of a group are numbered from left to right. In indicating a mine, give first the group, and then the mine number. Thus: group 2, mine 3.

Q. How are mooring ropes prepared?

A. The mooring ropes are cut off with square ends, and the ends passed through the holes in the mooring sockets. The strands and wires are untwisted and spread out for a length equal to the length of the socket hole. The rope is then pulled back until the ends are about flush with the top ends of the hole; a piece of marline is tied about the rope below the socket. If necessary to hold the socket, a piece of burlap may be wrapped around below the socket, and a fold allowed to fall over the hand. Set the socket upright while pouring full of alloy. Great care must be taken to see that there is no oil or water on the socket or mooring rope before pouring the alloy.

The length of the mooring rope for buoyant mines No. 32 equals depth at low tide, less 15 feet. This allows 5 feet for length of mine, anchor, and shackles, and 10 feet for submergence. When thimbles and clips are used, the mooring rope is cut three feet longer and is bent back a foot and a half at each end for the thimbles and clips.

For the larger mine cases, an additional allowance must be made for the length of the cylindrical part of the case.

The mooring ropes are tagged at each end with the number of the mine for which they were cut.

Q. What are the rules for the length of the mine cables?

A. Mine cables are cut to the following lengths, plus twice the approximate depth of water:

LENGTHS OF MINE CABLES

Nos. 1 and 19,	1425 feet,
Nos. 2 and 18,	1225 feet,
Nos. 3 and 17,	1025 feet,

Nos. 4 and 16,	825 feet,
Nos. 5 and 15,	725 feet,
Nos. 6 and 14,	625 feet,
Nos. 7 and 13,	525 feet,
Nos. 8 and 12,	475 feet,
Nos. 9 and 11,	425 feet,
No. 10,	375 feet.

Each cable is tagged with the number of the mine for which it was cut and a Turk's-head is made on each end.

Q. How and in what way are the cores of cables numbered?

A. The conductors of the 19 conductor cable are arranged in two layers around a single central conductor, the inner layer containing six, the outer twelve. One conductor in each layer is distinguished from the rest by some mark, usually a white thread on its surface. The marked conductor in the outer layer is number 1, that in the inner layer number 13, and the central conductor is number 19. The other conductors are numbered at the shore end of the cable in a clockwise direction; at the distant end these numbers run contra-clockwise.

Q. How are the mine cables prepared before putting them aboard the planter?

A. Each one must be coiled in a figure 8, with both ends free.

Start the coil about 135 feet (depending on the length of the planter) from the mine end of the cable and coil on the form, spreading out the laps at the center to keep the coil from building up too high.

The outer loops and the center are lashed, leaving ends to catch the mine cap end, which is then coiled on top and lashed.

The cable is now ready for test.

Q. How are the mine cables placed aboard the planter?

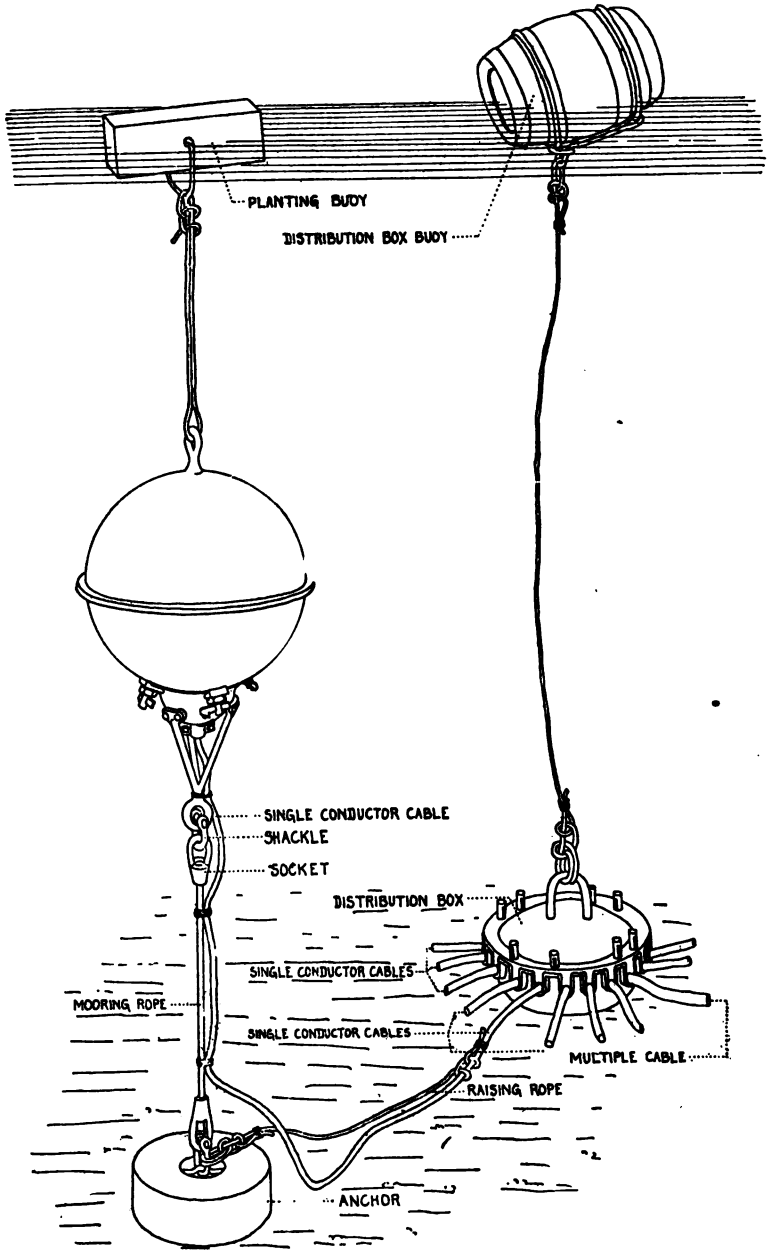
A. They are carried aboard or lowered by a derrick to the aft-deck.

The cable for No. 1 goes on the starboard side and its mine cap end is unlashed and carried forward close to the mines. Place Nos. 2 to 9 on the starboard side in same manner.

Place Nos. 19-10 on port side, with 19 at the bottom.

Q. How are the mines prepared for planting?

A. The detail on each side of the planter prepares a mine on its own side, but in no case should the mine or anchor be swung outboard until the preceeding mine has been planted from the other side.



MINE AND DISTRIBUTION BOX

Cut the loading wire of the mine to the proper length and connect to the conductor of its cable with a watertight joint. Clamp the Turk's-head in place, taking care that the wire is not caught under the clamp.

Lash the cable with wire or secure it by clips to the bails just above the ring.

Shackle the mooring rope, one end by the anchor, the other end to the mine, and lash it to the cable at every 5 feet with marline.

If automatic anchors are used, the mooring rope is shackled to the mine after the anchor and mine are swung outboard; the cable is not lashed to the mooring rope in this case.

Cut the raising rope 70 feet plus the depth of water and attach one end to the anchor by an anchor knot or bowline; the other end to the mine cable by two half hitches and a seizing of marline.

The mine buoys are attached with 60 feet of ½-inch rope, marked every five feet. Slip the free end through the maneuvering ring and tie it to the buoy.

Put a mousing around the upper hook of the block to prevent its jumping off when mine or anchor is tripped.

Pick up the anchor with the block on the forward davit and swing outboard clear of the rail. Pick up the mine by a rope sling through its ring with block on aft davit and swing it outboard clear of the rail.

Lower mine and anchor close to the water.

Bend a heaving line on free end of mine cable with a clove hitch and two half hitches.

The aft detail cuts the rope lashings of the coiled mine cable.

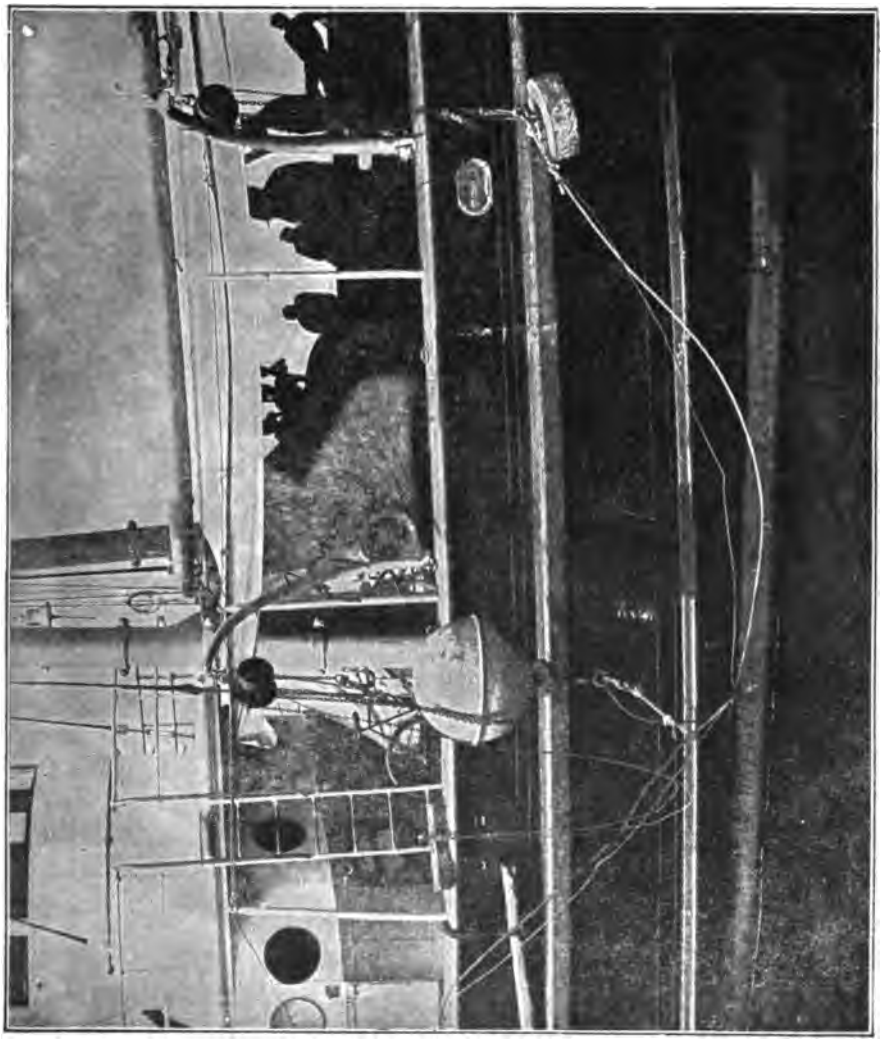
The cable and raising rope are held on the gunwale and a man should be ready to throw the mine buoy clear of the planter when the mine is tripped.

Q. What are the duties on board the distribution box boat before planting?

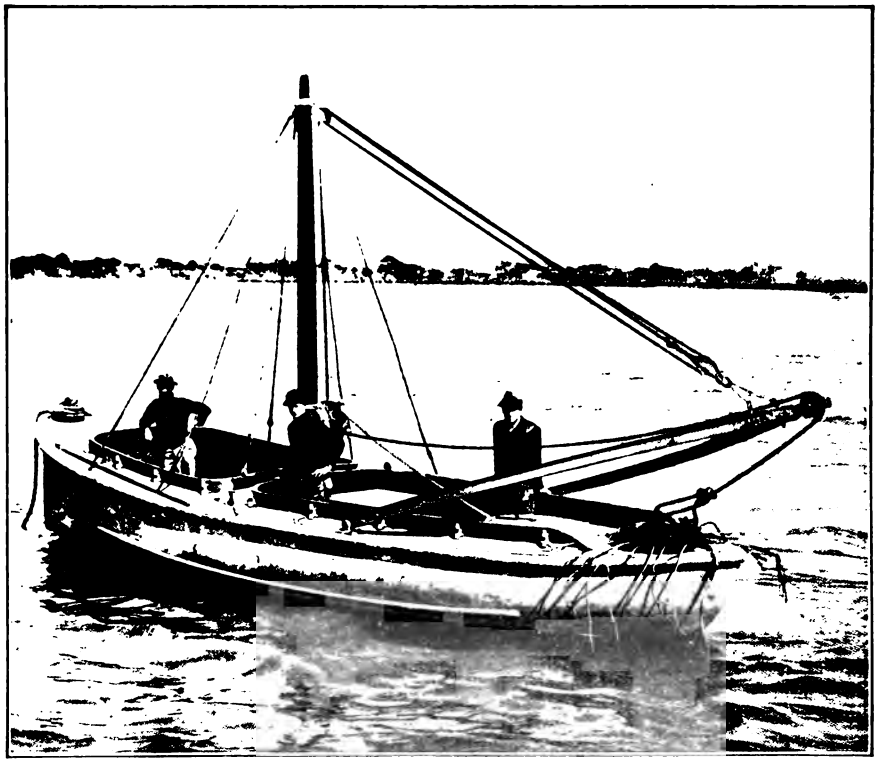
A. Precede the planter to the mine field and take the distribution box buoy aboard at the bow, if the tide is coming in towards the box, and make the anchor rope fast.

Raise the box with the raising ropes and secure it in the stern. Anchor the boat fore and aft, perpendicular to the line of mines, with bow towards center of the line.

If the tide is running out from the box, take the buoy in astern and hold the boat in position by the raising rope of the box and then by the cable.



MINE PLANTER WITH MINES ASSEMBLED READY FOR PLANTING



Department of Enlisted Specialists, C. A. S.

DISTRIBUTION BOX BOAT

The anchor rope is then made fast in the bow and during planting stand ready to slack away on anchor if necessary.

As soon as the box is secured, remove the lid and separate the conductors and attach one terminal of the boat telephone to No. 19 and earth the other. Tag the other conductors and notify casemate that the boat party is ready to verify tagging.

As casemate directs, touch the proper conductor to the armor of the cable and correct mistakes made, if any, in tagging. When told to prepare for insulation test, dry the conductor ends and hold them in the air separate from each other.

When directed, change the telephone to No. 1 and keep No. 19 clear of others in the air.

Q. What are the duties aboard the distribution box boat during planting of mines?

A. Catch the heaving line passed from the planter and haul the cable end in, bend on another heaving line and lash the cable to the boat. One of the crew stands by ready to cast off or cut the lashing, in case the cable is fouled by the planter.

As soon as the mine is dropped, remove the lashing and insert the Turk's-head in the proper seat and make a temporary joint with the proper conductor in the multiple cable.

Notify casemate that No. — is ready for test. When notified by casemate, make a permanent water-tight joint. When last mine is planted, remove telephone and leave temporary joint on for two minutes before opening it again and telephoning for result of test.

When the last permanent joint is made, close the distribution box and fasten raising rope to its lid and lower it in place.

Make anchor rope fast to the buoy with an anchor knot, and secure raising rope to the bight of this anchor knot by a lashed bowline.

Q. What are the duties on the planter during the planting of mines?

A. As the planter passes the distribution box boat, the heaving line on the mine cable is thrown by a man forward of the beam.

As soon as the cable is secure in the distribution box boat, the distance weight (if automatic anchors are used) is lowered at the command "Lower weight." At the command "Let go" the mine is tripped, then the anchor immediately afterward.

The mine buoy, cable, and raising rope are thrown overboard, all standing clear to prevent being caught.

When the stern of the planter is clear of the mine buoy, "All clear" is signalled from the stern.

Q. What are the duties in the two small boats during planting?

A. Two boats, one on each half of the line, work as follows:

As soon as a mine is dropped, the boat on whose side it is picks up the buoy, pulls the rope taut, notes the depth, notifies planter and holds up an oar over the mine.

After the observers on shore have taken a reading, the boat holds to this buoy until the next mine on its side is planted.

They remove the mine buoys when so directed.

Q. Explain how soundings for a group are made.

A. A buoyed anchor is dropped about 350 feet in front of the distribution box buoy. This marks the position of mine number 10 and of the center of the group.

This marking buoy is picked up by a launch which makes fast to the anchor rope. The planter now passes the launch one end of a measuring line which has single marks at 280, 300, 350, 580, and 600 feet. The planter moves out slowly along the line to be occupied by the mines, unreeling the measuring line as it goes, and drops buoys at the 300 and the 600 marks. It then returns and does the same for the other side of the line. These five buoys mark the line to be occupied by the mines, indicate the positions of mines number 4, 7, 10, 13, and 16, and, in addition, cut up the distance into 300-foot lengths, which enables the planter to plant mines at a close approximation to 100 feet apart.

When automatic anchors are used, such information as may be required about the depth of the water may usually be obtained from charts. This may not be sufficiently accurate for planting with ordinary anchors. In the latter case, soundings must be taken at the spots where the mines are to be planted.

These soundings are made from the launches. The launches take a measuring line, stretch it between the planted buoys and take soundings at every 100-foot point. The soundings are recorded in a blank book, showing the number of the corresponding mine and the state of the tide. It may be found more satisfactory to hold one end of the measuring line at the buoy and circle across the line of mines with the launch, getting the soundings at the point of crosing.

(See Appendix "D," "Manual for Small Boats.")

(See Appendix "E," "Duties of Planter Details.")

(e) CORDAGE, BLOCKS, GINS, SHEARS, AND JACKS

CORDAGE

Q. Define yarn, strands, jaws of a rope.

A. A yarn is a thread of hemp or other fibrous material.

A strand is a number of yarns twisted together.

The jaws are the spaces between the strands of a rope.

Q. Make a square knot; bowline; rolling hitch; blackwall hitch; round turn and two half hitches; clove hitch; long splice; short splice; anchor knot. Explain the use of each.

A. Square knot, for joining the ends of two ropes the same size.

Bowline, to form a temporary loop at the end of a rope.

Rolling hitch, for fastening a rope to a strap or tail block, and to secure a fall while being shifted on a windless or capstan.

Blackwall hitch, for fastening a rope to the hook of a block.

Round turn and two half hitches, to secure guys to stakes.

Clove hitch, for fastening a rope to a spar.

Long splice, for splicing a rope without increasing its diameter at the place of splice.

Short splice, for splicing a rope allowing an increase in diameter at the place of splice.

Anchor knot, for fastening a rope to an anchor or ring.

Q. How is rope stored?

A. Rope should be stored in a dry cool place and in such a manner as to allow a free circulation of air through its coils.

Q. How is rope treated after being used before storing?

A. It should be thoroughly dried, carefully examined for any evidence of chafing or deterioration, and, if practicable, all sections dangerously weakened should be cut out and the rope spliced at these places.

Q. What is whipping?

A. Wrapping the end of a rope to prevent its unraveling.

Q. What is splicing?

A. Joining the ends of ropes by intertwining the strands.

Q. What is worming?

A. Filling the jaws of ropes so as to make a smooth surface.

Q. What is parceling?

A. Wrapping (with the lay of the rope) with strips of canvas so as to protect a rope.

Q. How do you serve a rope?

A. By worming, then parceling, and finally laying on spun yarn or other small stuff around the rope in turns close together against the lay of the rope.

Q. What is a strap, or sling, and for what is it used?

A. It is formed by knotting or splicing together the ends of a short rope. It is used for hooking tackles into.

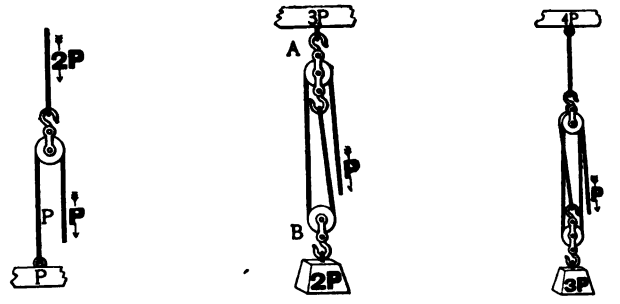
Q. Mouse a hook and explain its purpose.

A. It is seizing placed around the jaw of a hook to prevent it from spreading or unhooking.

BLOCKS

Q. Name the different parts of a block and point them out.

A. Shell, sheave, pin, strap.



WHIP TACKLE GUN TACKLE LUFF TACKLE

Q. Mention the different kinds of blocks.

A. Single, double, treble, snatch, and tail blocks.

Q. What is a tackle?

A. It is a purchase formed by rigging a rope through one or more blocks.

Q. Point out the running part, the standing part, and the fall.

Q. Rig the following: Whip, gun tackle, luff.

A. See illustration.

Q. What is meant by the power of a tackle?

A. The number obtained by dividing the weight raised by the force applied on the fall necessary to balance the weight. In an ordinary tackle the number of ropes running from the movable block is the "power."

Q. Examine a triplex block and explain its use.

A. A triplex lock is a device used to lift a heavy weight with the use of a small amount of power.

For many purposes it is much better than any form of tackle.

It consists of a train of gears operated by a large wheel over which passes a light chain. Power is applied to this chain. The gears operate a small wheel or sprocket, over which runs a heavy chain. The heavy chain raises the weight. A hook is bolted to one side of the casing for attaching the block to a crane or davit.

Q. Examine a tripping hook and explain its use.

A. A tripping hook consists of a hook with a long shank. The hook is pivoted at the end of a slot in a round piece of steel so that when the shank is in the slot, the hook is in the proper position to hold a weight. The shank is held in place by a sleeve, to which is attached a small rope. A spiral spring keeps the sleeve in place. With a weight hanging on the hook, if the rope be pulled, the sleeve is withdrawn from the shank and the hook swings, allowing the weight to drop.

Tripping hooks are used on the triplex blocks attached to the mine and anchor davits on board the mine planter. The mine and anchor each hang on a tripping hook when ready for planting.

GINS

Q. Describe a gin.

A. A gin is a tripod formed of three poles. The two outside ones are called legs, the third one the pry pole. A gin requires no guys.

Q. What is it used for?

A. For lifting weights *vertically*.

Q. Name the different parts of a garrison gin.

A. Two legs, pry pole, bolt and clevis, windlass, two hand spikes, three shoes, two braces, and tackle.

Q. How much can be safely lifted with it?

A. 17,000 pounds.

Q. Explain briefly how it is assembled and raised.

A. The legs and pry pole are laid on the ground with the heads together and in position for assembling.

The head is then assembled by putting the pin through the pry pole, clevis, and legs. The windlass is put in place and the braces are brought up and put in their places.

The gin is raised, after being put together, by raising the head and bringing up the foot of the pry pole towards the feet of the other two legs.

Q. How can the upper block be placed in position after the gin has been raised?

A. By rigging a trace rope through the clevis of the gin and shell of the block and hoisting it up.

Q. What are the principal uses of the garrison gin?

A. For lifting vertically any weights within its capacity. It is designed especially for use around the gun and mortar emplacements.

SHEARS

Q. Describe shears.

A. Shears consist of two spars, of a size suitable for the weight to be raised, lashed together at the cross. A tackle is fastened at the lashing by a strap passed around it or otherwise; the hook is moused; and holdfasts are required.

Q. What are shears used for?

SHEER LASHING

A. Shears are used for lifting heavy weights where the lift is *at an angle*, that is, *not* vertical.

Q. How is a shear lashing made?

A. The spars are laid parallel, a couple of inches apart, on a block; a clove hitch made on one spar; then five or six turns taken around both spars without riding. Several turns are then taken between the spars, and the end fastened on one of the spars with a clove hitch. One spar is then lifted and placed on top of the other and the lower ends separated until the heels are the proper distance apart. This tightens the lashing and adjusts the shears for raising.

Q. How are shears held in position after being raised?

A. By means of guys.

Q. How and when is the tackle made fast?

A. By means of a strap passed around the head, which is done before the shears are raised.

Q. How are they rigged?

A. After lashing, lay the heads of the spars on a trestle about three feet high.

A guy strap having the splice in the center, so that the splice cannot come into either bight, is then laid between the spars above the cross and equally divided, each bight led around the spar farthest away from the guy for which it is intended, the bights brought back around both spars, for the upper guy block to be hooked to, or the guy rope itself is attached to the guy strap. The other guy strap is put on in the same manner, the strain on each guy thus tending to bind the spars together.

The main tackle sling is then put on over the cross from front to rear passing over the guy straps. The upper block of the main tackle is then hooked through both bights of the main sling and the hook moused.

Prepare the holdfasts for the foot ropes, to prevent the heels from slipping while raising, and for the guy ropes when the shears are ready for raising.

Q. How are the shears raised?

A. If not too heavy, lift the head and haul in on the proper guy. If too heavy to raise in this way, form a crutch by lashing together two poles near their upper ends, the feet of the crutch being slightly in rear of the heels of the shears and secured to prevent them from slipping. Lay the rear guy over the crutch and raise the crutch by means of two light guy ropes, until it is inclined at an angle of about 45° to the front. Haul on the rear shear guy, allowing the crutch to rise as the shears rise. After the shears are raised high enough so that the crutch ceases to act, it is lowered by means of its guy ropes.

HYDRAULIC JACKS

Q. For what is a hydraulic jack used?

A. For lifting heavy weights.

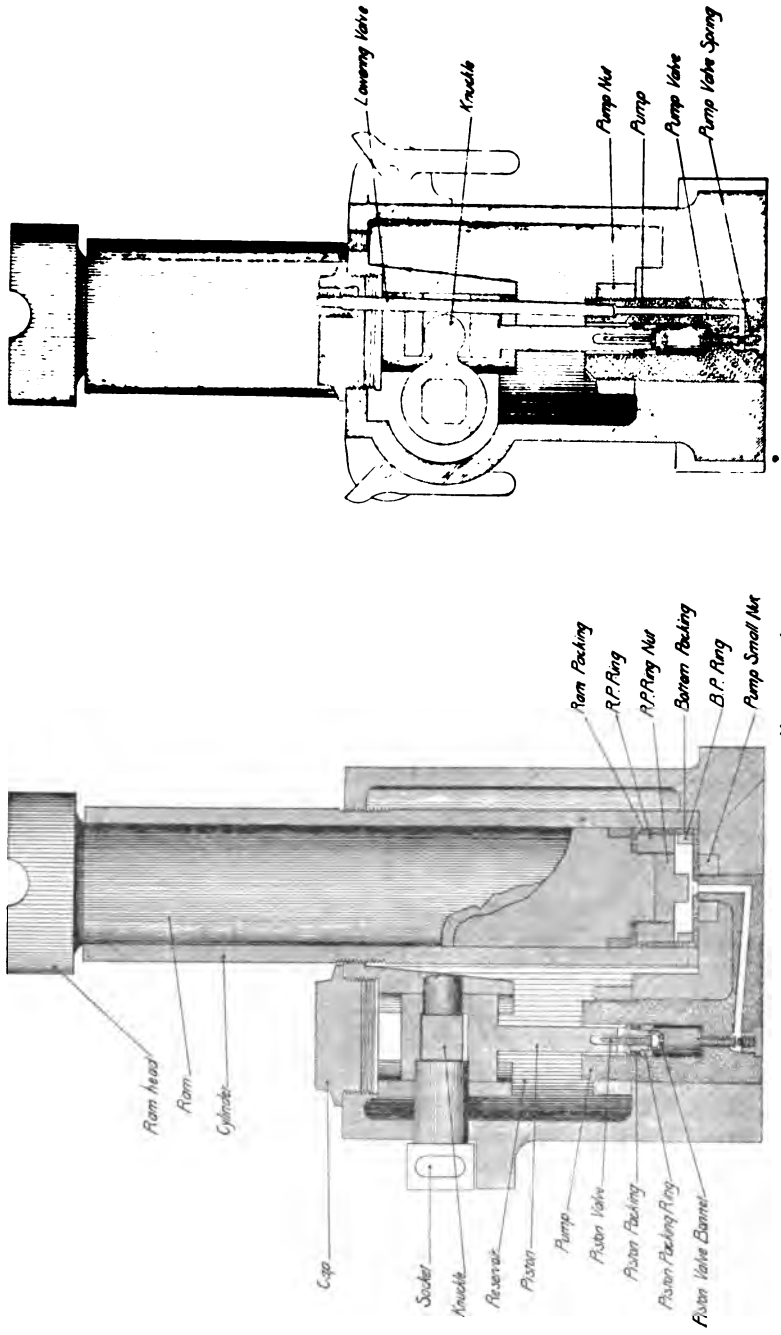
Q. What liquids are used in the jack?

A. Alcohol (*not wood alcohol*) one part and water two parts, for the base jack; and for the horizontal jack, one part of alcohol and one part of water.

In each case a tablespoonful of sperm oil is added.

Q. How is the jack filled?

A. After cleaning, fill through the large hole, replace hexagonal cap, and then the lowering valve. In case it is

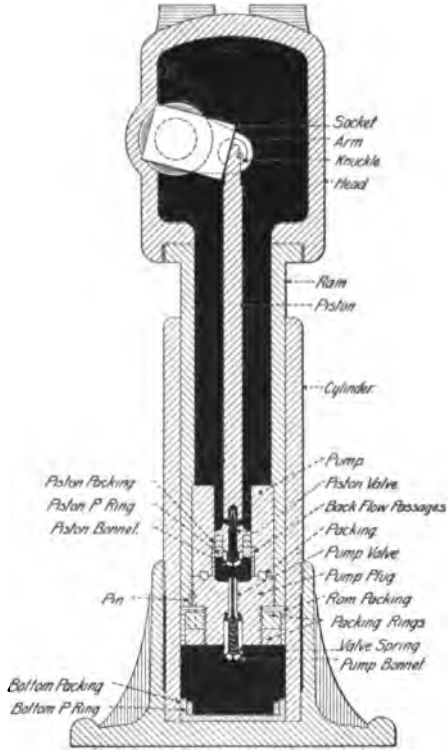


HORIZONTAL JACK

necessary to add a little liquid to replace that which has leaked out, and at the place of work, remove small screw, fill, and replace the screw. This is to prevent sand from entering the pump mechanism. The ram should be down in both operations.

Q. How is the jack emptied?

A. With the ram down, place the finger over the escape hole in the cylinder, pump the ram until the bottom of it is



BASE JACK

above the hole, then open lowering valve, remove the finger, and allow the air to enter under the ram. The ram can now be easily pulled out.

Remove the lowering valve and hexagonal cap and invert jack to allow liquid to run out.

(NOTE.—If the jack has lowering valve near bottom, only the cap need be removed.)

Caution.—Always insert the lever in the socket with the projection down.

Q. How is a jack cared for when not in use?

A. The jack should always be kept filled and clean and free from rust. The ram should be kept down. Never fill with water, kerosene, or wood alcohol, which cause it to rust.

Q. Show how a jack is used in moving a heavy weight.

A. See that the bottom of the jack has a firm bearing surface, and that the top of the ram presses securely against the weight to be moved. Tighten the lowering valve, and work the handle with a slow, steady stroke.

Q. What is the difference, if any, in the use of a base and a horizontal jack?

A. A horizontal jack may be used equally well in a horizontal or an upright position. A base jack may be used standing or at an angle, with the limitation that the head must be a little higher than the foot, so that the pump will be always submerged.

Q. How is a heavy weight lowered with a jack?

A. Care must be taken not to let the ram down too fast nor to check it too suddenly. Loosen lowering valve very slowly, bearing in mind that to avoid accident the weight must be "followed down" with blocking.

Q. How is a claw used with a jack?

A. When it is impossible to get the head of the jack under the weight, a claw is used. One end is placed under the object to be raised and the other end of the claw over the head of the jack.

(f) U. S. MAGAZINE RIFLE

Q. Point out the following parts:

Barrel.	Firing pin sleeve.
Front sight.	Striker.
Stacking swivel.	Main spring.
Stock.	Extractor.
Upper band.	Safety lock.
Lower band swivel.	Cut-off.
Grasping groove.	Cocking piece.
Hand guard.	Ejector.
Rear sight.	Magazine.
Movable base.	Floor plate.
Windage screw.	Guard.
Windage scale.	Trigger.
Drift slide.	Lower band.
Slide.	Butt swivel.
Slide screw.	Butt plate.
Range scale.	Bayonet.
Bolt.	Bayonet guard.
Bolt handle.	Bayonet grip.
Locking lug.	Bayonet catch.
Sleeve.	Oiler and thong case.
Firing pin.	Brush and thong.

Q. What is the kind and weight of charge of powder for ball cartridge?

A. About 50 grains of pyrocellulose smokeless powder.

Q. What is the kind and weight of charge of powder for the new model blank cartridge without paper bullet?

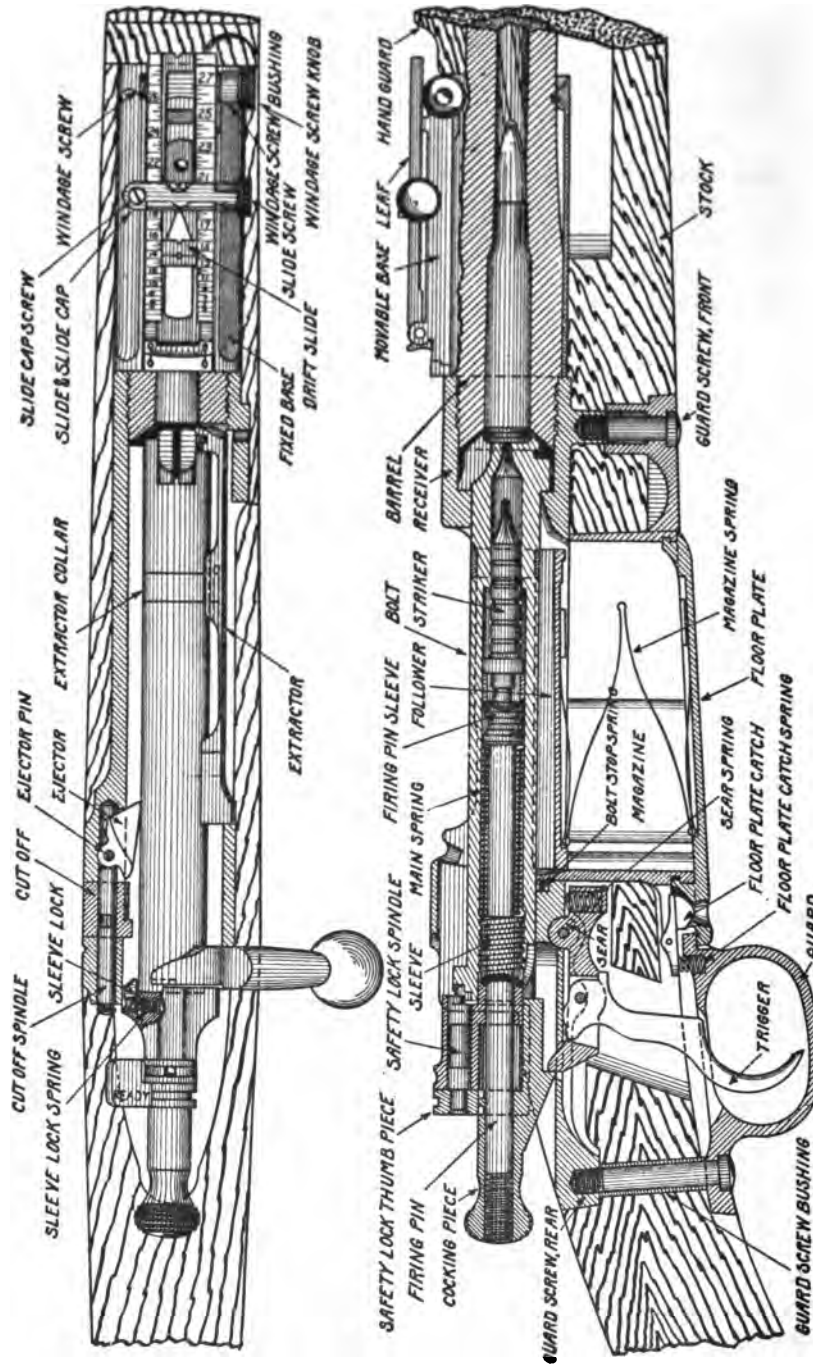
A. 12 grains of smokeless powder.

Q. What is the kind and weight of charge of powder for the guard cartridge?

A. About 9 grains "bullseye" powder, or about 17 grains DuPont Rifle Smokeless No. 1.

Q. Describe the bullet for ball cartridge.

A. It has a core of lead and tin composition inclosed in a jacket of cupro-nickel. It weighs 150 grains. The point is very sharp so as to offer little resistance to the air. The bullet is grooved to receive the crimp of the case, and its base is flat.


SLIDE CAPSCREW
WINDAGE SCREW
WINDAGE SCREW BUSHING
SLIDE & SLIDE CAP
SLIDE SCREW
WINDAGE SCREW KNOB
FIXED BASE
DRIFT SLIDE
EXTRACTOR COLLAR
EXTRACTOR
CUT OFF
EJECTOR PIN
EJECTOR
SLEEVE LOCK
CUT OFF SPINDLE
SLEEVE LOCK SPRING
READY
HAND GUARD
LEAF
MOVABLE BASE
BARREL
RECEIVER
STOCK
GUARD SCREW, FRONT
BOLT
STRIKER
FOLLOWER
FIRING PIN SLEEVE
MAIN SPRING
SAFETY LOCK SPINDLE
SLEEVE
SAFETY LOCK THUMB PIECE
FIRING PIN
COCKING PIECE
GUARD SCREW, REAR
MAGAZINE SPRING
FLOOR PLATE
BOLT STOP SPRING
MAGAZINE
SEAR SPRING
FLOOR PLATE CATCH
FLOOR PLATE CATCH SPRING
SEAR
TRIGGER
GUARD
GUARD SCREW BUSHING

Q. Describe the bullet for the old style blank cartridge.

A. The bullet is of paper, hollow, and contains a charge of 5 grains of smokeless powder, which insures the breaking up of the bullet on leaving the bore. The propelling charge is 10 grains of smokeless powder.

Q. Describe the bullets for the dummy and guard cartridges.

A. The same as the bullet for the ball cartridge. To distinguish it from the ball cartridge, the dummy cartridge has a tinned case provided with six long straight grooves along it and three holes through it. The guard cartridge is distinguished from the ball cartridge by having either 5 grooves around the case (old style), or six short straight grooves at the shoulder (new style).

Q. What is the muzzle velocity of the ball cartridge?

A. 2700 f.s.

Q. What is the muzzle velocity of the guard cartridge?

A. 1200 f.s.

Q. Illustrate to the instructor how you would set the sight for a given range, using both open and peep sights.

Q. To shoot to the right (or left), which way would you move the sight?

A. To shoot to the right move the movable base of the sight to the right; to shoot to the left, move the movable base of the sight to the left.

Q. How much does one point on the windage scale correct for?

A. About 4 inches for every 100 yards of range; so at 300 yards range one point corrects for about 13 inches.

Q. Using the guard cartridge how would you set the sight for range 100 yards? 200 yards? 300 yards?

A. At 100 yards set the sight for 450 yards. At 200 yards set the sight for 650 yards. At 300 yards set the sight for 850 yards.

Q. What is the range of battle sight?

A. About 550 yards.

Q. In firing with battle sight, how high is the trajectory above the line of sight at 200 yards.

A. 2¼ feet.

Q. At 300 yards?

A. 2½ feet.

Q. How do you aim in using battle sight at less than 550 yards.

A. Aim at the earth just beneath the target or at the lower edge of the target.

Q. What oils can be used on rifles?

A. For metallic surfaces: sperm oil, cosmic, or "3 in 1"; when arms are stored, cosmic should be used. For the stock: raw linseed oil; when in the field, the stock should be wiped off occasionally with a cloth moistened with any of the oils enumerated above.

FIRST CLASS GUNNERS

(a) CARE AND PRESERVATION OF MINE MATERIAL

Q. What are the duties of the non-commissioned officer in charge of the store-house?

A. He keeps all material in the best possible condition.

He checks up all articles taken out during practice and reports all shortages at the end of the day's work.

Q. How are paints and oils stored?

A. Separate from other stores; and the floor of the place of storage is kept covered with 2 or 3 inches of sand. The sand should be renewed occasionally. Never use sawdust for this covering.

Q. What are the precautions to be taken with gasoline?

A. It should be stored in tanks underground and never inside buildings.

Place small quantities outside of buildings in some safe place.

Never bring a flame or open light near it.

Q. How and where is light slushing oil used on mine material?

A. It is applied in a thin coating to the bright parts of engines and generators out of commission, brass screw threads, and parts of tools liable to rust.

Also to screw threads of mine cases, the steel threads of compound plugs, bolts, washers, nuts, and flat surfaces of joints.

(Caution: Keep oil and grease off the contacts of electrical instruments, india rubber, ebonite, and slate.)

Q. What are the rules for the storage of mine cases?

A. They should rest on racks or skids and, when possible, should not touch each other.

In handling them take care not to injure the bails or bolts.

They should be arranged so that the holes are in sight, and these holes should be fitted with greased wooden plugs.

The galvanized cases will not ordinarily need painting till they have been in the water. When taken from the water they should be thoroughly dried and all rust removed with wire brushes and steel scrapers.

Then apply a heavy coat of red lead, and when dry a coat of gray paint.

Mine cases, in storage, must be frequently inspected inside and outside for any signs of rusting.

Q. For what is asphaltum varnish used?

A. For painting anchors, distribution boxes, junction boxes, mooring sockets, shackles, sister-hooks, and iron work of operating boards.

Q. How do you take care of paint brushes?

A. When new they should be wrapped with strong twine and soaked in water.

After use they should be cleaned with turpentine and put away in water.

Q. How are ropes cared for?

A. The large ones should be stored on skids to admit the air around them, small ropes should be hung on wooden pins.

They should be uncoiled twice a year and laid out to dry when the weather is suitable.

Wire rope must be kept dry and free of rust.

Q. What rules are there for oiling marline covered rope?

A. If not used in five years or if it has been used in water, it is reeled through a tub of tar oil, and the excess oil slicked off with a piece of burlap before it goes to the new reel. The reel is then allowed to drain for two or three days over sand.

(b) HANDLING HIGH EXPLOSIVES

Q. What explosives are used in mines?

A. Wet gun cotton and trotol. Dynamite and other commercial explosives may be used in an emergency.

Q. What are the precautions to be observed in loading mines?

A. Funnels are used to cover the screw threads.

Trotol is poured through the funnel. Guncotton or dynamite are passed through the funnel by hand.

The screw threads are wiped carefully before inserting the compound plug.

The skids are placed upon a piece of canvas spread out on the floor of the loading room. When through, the canvas should be taken up and thoroughly cleaned. The floor of the loading room should be scrubbed and all refuse destroyed.

Q. How are fuses and primers stored?

A. They must be stored separately from each other and away from any other explosive.

Dynamite, wet guncotton, and trotol can be stored in the same magazine.

Q. How can you destroy nitroglycerin if it has stained floors, etc., of the magazine or loading room?

A. Boil 50 pounds of lime in a barrel of water and add powdered sulphur till no more dissolves. (About 20 pounds.)

Filter this through cheese cloth and spread the solution over all places where the nitroglycerin has been.

Q. How is frozen dynamite thawed?

A. The best method is to leave boxes open for several hours in a warm room. If time be lacking, the dynamite may be thawed by placing it in an open, water-tight can and placing the can in warm water no hotter than can be easily borne by the hand.

Q. Where is the main supply of explosive kept and how much is taken out at one time to the explosive house near the loading room?

A. It should be kept in a cool magazine, in which the temperature does not fall below 45°F., nor go above 100°F., and where there is no dripping of water. Only enough should be taken out at a time for one group of mines.

(See Appendix "I," "Storage and Care of Explosives.")

(c) AZIMUTH INSTRUMENT AND PLOTTING BOARD

Azimuth Instrument

Q. What is the name of this instrument?

A. The Warner and Swasey Azimuth Instrument, Model 1900 (or 1910).

Q. Define an angle.

A. An angle is the difference in direction of two straight lines that meet or would meet if sufficiently prolonged.

Q. Draw with chalk, or pencil, an example.

Q. What is a vertical line? Give an example of a vertical line.

A. A line that runs straight up and down; for example, a plumb-bob line.

Q. What is a horizontal line?

A. One that is perpendicular to a vertical line; or, the axis of the spirit level, when bubble is centered.

Q. What is a plane?

A. That which has length and breadth but no thickness.

Q. What is a vertical plane?

A. One containing a vertical line.

Q. What is a horizontal plane?

A. One perpendicular to a vertical line.

Q. Define a horizontal angle.

A. A horizontal angle is one included between two lines lying in the same horizontal plane.

Q. What is a vertical angle?

A. A vertical angle is one included between two lines lying in the same vertical plane.

Q. What kind of angles are measured by the azimuth instrument?

A. Horizontal angles.

Q. How is the instrument graduated to read?

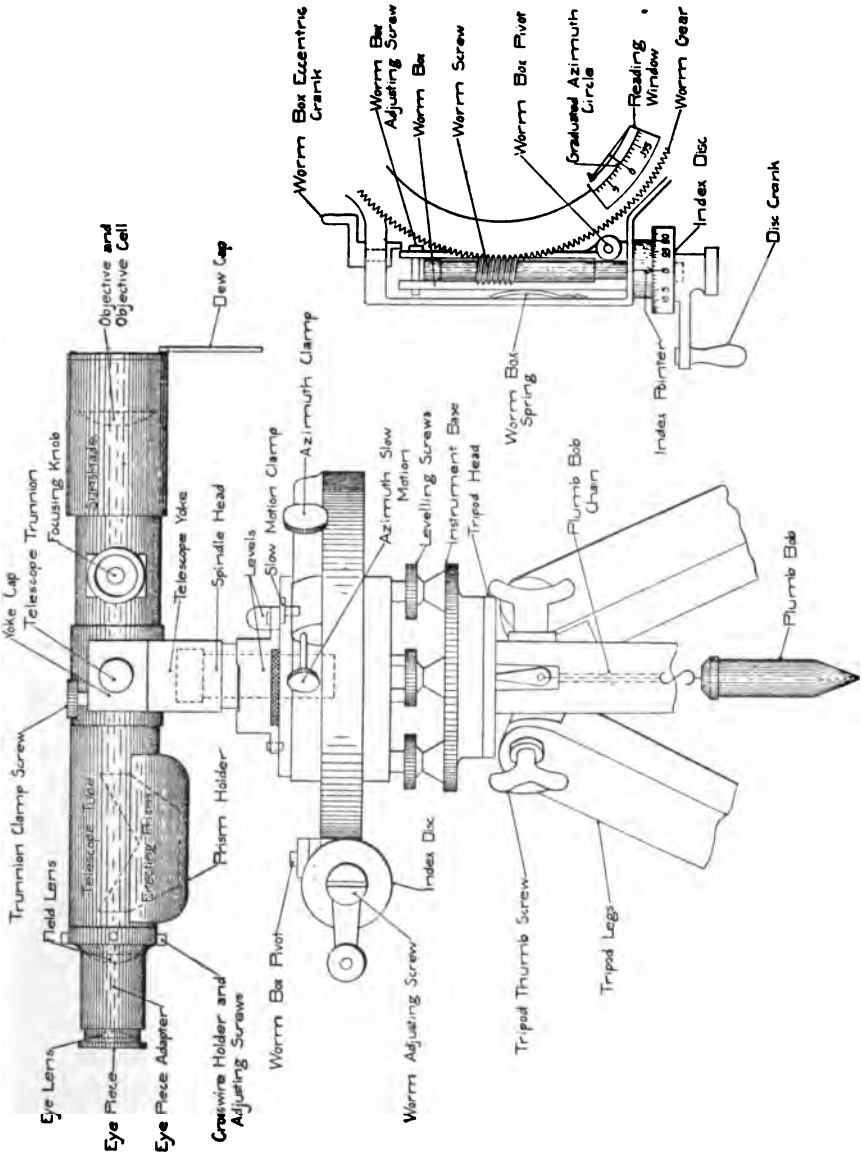
A. In degrees and hundredths of a degree.

Q. Where are the degrees read?

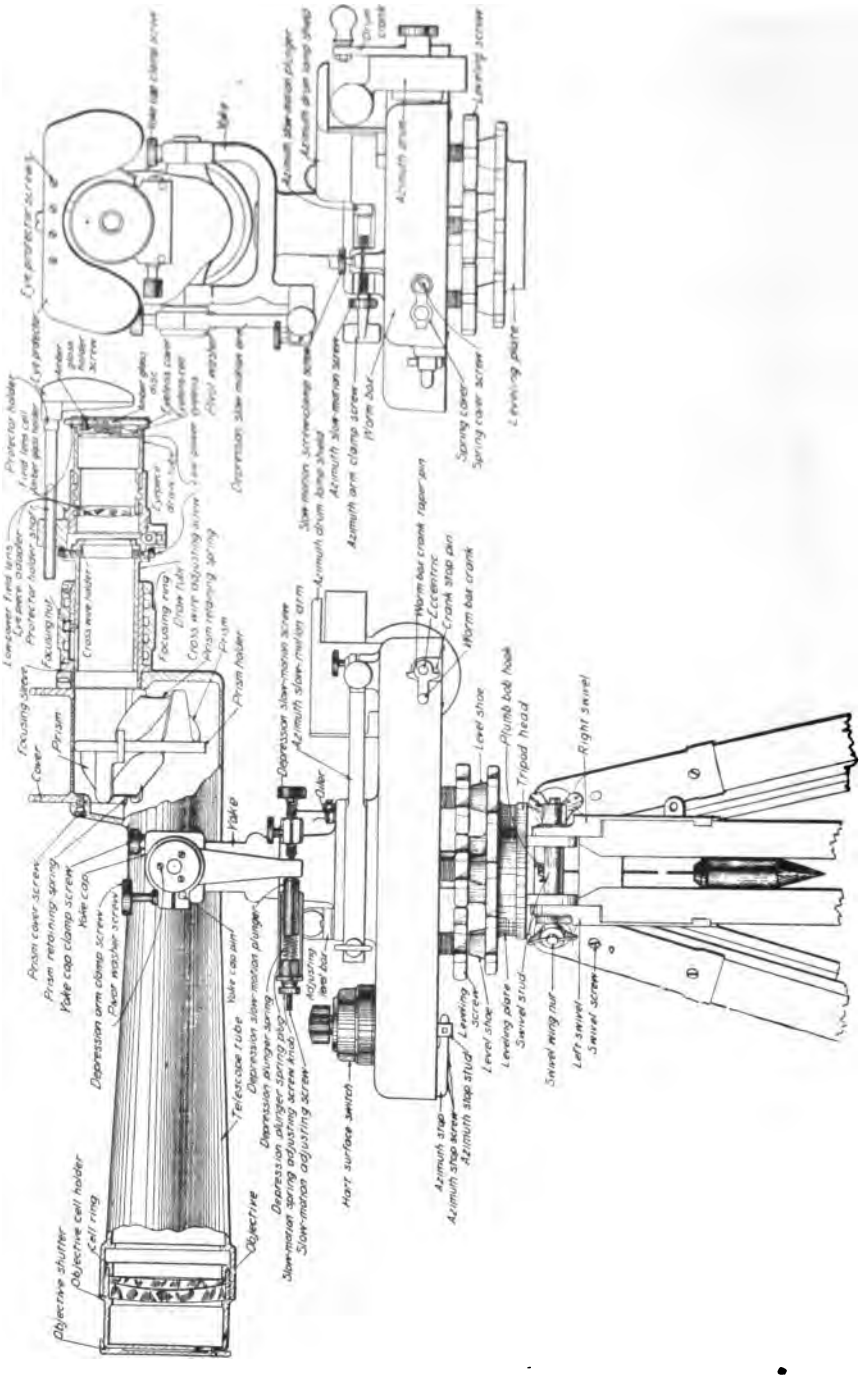
A. On the graduated limb?

Q. What is the value of a space on the limb?

A. One degree.



AZIMUTH INSTRUMENT, MODEL 1900



AZIMUTH INSTRUMENT, MODEL 1910

Q. Where are the hundredths of a degree read?

A. On the graduated index disc.

Q. What is the value of one space on the index disc?

A. One one-hundredth of a degree.

Q. What is meant by orienting the instrument?

A. It means adjusting the instrument so that it will read correct azimuths.

Q. What is an azimuth?

A. It is a horizontal angle measured from the south point (which is zero) of a north and south line, in a clockwise direction, to a line joining the target and instrument.

Q. Describe how to level and orient the azimuth instrument.

A. The instrument is said to be oriented when it is set up so that it will read azimuths. The operation is as follows:

1. Set the graduated circle and index disc to read the azimuth of a known datum point.

2. Make sure the azimuth slow motion screw is about the middle of its play; then, with the azimuth clamp screw loosened, set the eyepiece slightly to the left of the reading window and clamp the azimuth clamp.

3. Raise the whole instrument by grasping the top (*not the telescope*) and turn it so that the telescope points in the general direction of the datum point with the plumb bob over the home station. In orienting the instrument on a pier mount, the instrument may be turned in the proper direction by loosening all of the leveling screws.

(Second and third are not essential to the reading of azimuths, but are provided so that when the adjustment is complete the parts of the instrument will be in the most convenient relative position for operation and reading.)

4. Level the instrument. See that all the screws have a uniform and firm bearing on the leveling plate; turn the worm box eccentric crank so that the worm is released; set one of the levels exactly over two opposite leveling screws, then turn these two screws either both inward or both outward until the bubble comes in the center, being careful to maintain a firm bearing of the screws on the plate. Then perform the same operation with respect to the other two leveling screws. (The bubble moves in the direction of the left thumb in screwing the leveling screws.) Turn the instrument through 180 degrees and if the bubble does not remain in the center, correct one-half of any variation of either bubble by the ad-

justing screws on the level, the other half by the corresponding leveling screws. Repeat this operation until the bubbles remain in the middle of the tubes for any position of the telescope in azimuth.

5. Focus the telescope.

6. Bring the vertical wire of the telescope approximately on the datum point; having set on the azimuth circle and index disk the azimuth of this point; tighten the azimuth clamp, and, using the azimuth slow motion screw, bring the vertical wire exactly on the datum point. Clamp the slow motion screw.

Q. How is back-lash eliminated?

A. Adjust the *worm box adjusting screw* so that there is no play between the worm and the worm gear; adjust the *worm adjusting screw* till there is no longitudinal play of the worm in its box. The disc crank should turn freely—neither too tight nor too loose.

Q. How is the telescope of an azimuth instrument focussed?

A. Focus the eyepiece until every roughness on the cross-wires is seen.

Then turn the telescope on some distant object and focus the objective by means of the focussing knob until the vertical wire remains on the same point of the distant object, when the eye is moved to right and left. If the object appears indistinct when the parallax is removed, refocus the eyepiece and objective (changing a little each time) until the object is seen clearly.

Q. Set up, under direction of the instructor, the azimuth instrument over a given point; level, orient, and focus it.

Q. Direct instrument on five successive points (whose azimuths the instructor has previously determined) and read the instrument.

Q. What precautions must be observed in caring for this instrument?

A. Never touch the lenses with the fingers.

Clean the lenses only with soft linen or "optical paper," making sure there is no grit on the linen or paper.

Do not jar the instrument, as a jar may cause the prisms to slip.

Protect the instrument from dust and moisture.

Do not turn the leveling screws as hard as you can.

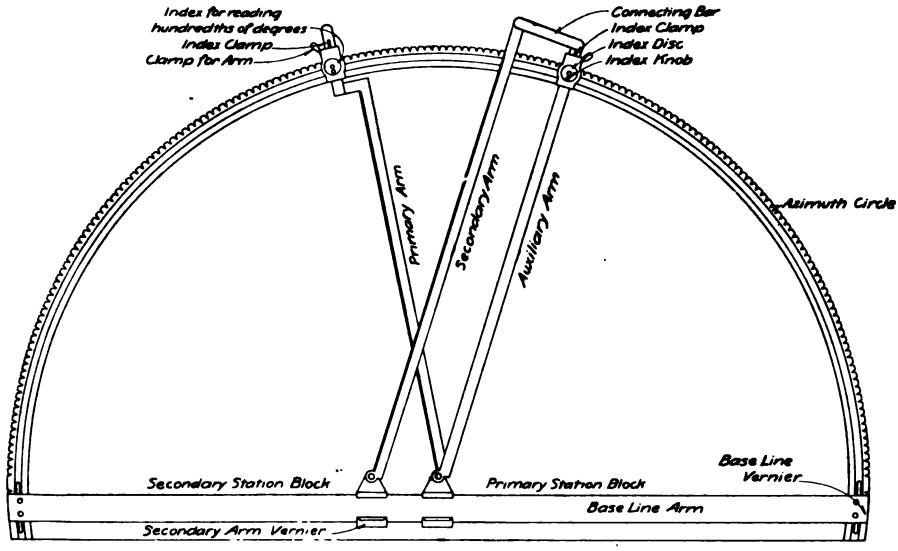
THE PLOTTING BOARD

Q. Point out the following:

Primary station.
Secondary station.
Primary arm.
Secondary arm.
Coupler.
Base line.
Azimuth circles.

Q. What is the scale of this plotting board?

A. 100 yards = 1 inch.



MINE PLOTTING BOARD

Q. Lay off a distance on the board of _____ yards.

Q. Find the distance between two given points.

Q. Range and azimuth of a point from primary station being given, locate point on board.

Q. Range and azimuth of a point from secondary being given, locate the point.

Q. Explain the method of computing the time from any plotted point to a mine.

A. The time that a target will take to travel from any plotted point to a mine will depend upon two things—the speed of the target and its distance from the mine.

The distance passed over by a target on any scale in 15* seconds, and the distance to the nearest mine in the course of the target are read. The problem then is to determine how long it will take a target to pass over a given distance, if it passed over another given distance in 15 seconds.

Using the prediction ruler, move the slide until the graduation corresponding to the "Yards in 15 seconds" is opposite the graduation corresponding to the "Yards to mine" and read the "Fire at time" scale opposite the arrow on the slide. The reading will be the number of seconds from the last plotted position to the mine which the vessel is approaching.

Q. Act as plotter.

A. The primary arm setter sets the primary arm at the azimuth sent him from the primary observing room. The secondary arm setter sets the secondary arm at the azimuth sent him from the secondary station at the same instant. The intersection gives the position of the target at the instant. The plotter marks the point of intersection when the arm setters call, *Set.* He connects the successive positions of the target by a straight line, thereby indicating the course of the traget. In observation firing, when the target approaches a line of mines, and it is evident that it will pass near a mine within 30 seconds time, he will, on the third stroke of the time interval bell indicating the next interval, start his stop watch and plot the position of the target. He will then place the zero of his scale on the last plotted position and read the scale back to the previous plotted position, and also forward to the line of mines. He will then announce, *Group*—, *Mine*—, indicating the group and nearest mine in the course of the target, by telephone to the casemate. At the proper time, as found from the prediction rule, he will give the command 1. *Ready,* 2. *Fire,* to the casemate. He will continue plotting the target until another is announced, or *Cease Tracking* is commanded. He will locate on the course of the target, as nearly as possible, its position at the time of fire.

*The observing interval is now 15 seconds.
A new arrow head should be cut on the slide at 75, and the one at 150 should be effaced.

(d) ENGINES, GENERATORS, TRANSFORMERS, STORAGE BATTERIES, AND SEARCHLIGHTS, ASSIGNED TO THE COMPANY

ENGINES

(a) *Casemate Oil Engine*

Q. Describe the casemate oil engine. (Illustration, page 41.)

A. The principal parts of the engine are: Base, Oil Reservoir, Bed Plate, Cylinder, Vaporizer, Piston, Connecting Rod, Crank Shaft, Fly-Wheels, Cam Shaft, Governor, Oil Pump, Valve Box, Starting Lever, Overflow Glass, Air Cam, Air Inlet Valve, Exhaust Cam, Exhaust Valve, Water Cooling System, and Lamp.

The engine operates as follows: As the piston moves forward, oil is sprayed into the vaporizer and vaporized by striking the hot walls opposite, and at the same time air is drawn into the cylinder; as the piston returns, the air and gas are mixed, and near the end of the stroke an explosion takes place which moves the piston forward again. During its return the products of the explosion are forced out through the exhaust valve. The above operations are continued. It is seen that the piston receives an impulse due to the explosion every two revolutions of the fly-wheel.

Q. What is the oil engine used for?

A. It is used to drive the casemate generator which is a source of direct current for use in charging the storage battery.

Q. Describe how to operate and care for the oil engine.

A. (a) See that the water supply is all right. The water in the tank should be above the return pipe. See that the cocks which admit water to the water jacket of the vaporizer valve box are open; also that the cock on the main water pipe from the bottom of the tank is open, and the drain cock closed.

(b) See that there is oil in the reservoir.

(c) Start the lamp and place it under the vaporizer.

(d) Open the relief cock.

(e) Turn the engine forward until the crank pin is down.

(f) Throw the lever—"TO START."

(g) Fill the oilers and see that the valve from the reservoir

to the supply pipe is open. The vaporizer should be heated from 10 to 20 minutes. Never try to start unless it is red hot.

(h) Give several strokes to the pump. Oil should overflow at the glass.

(i) Turn hand regulator to "OPEN."

(j) Give two strokes to the pump. Vapor will issue from the cock on the cylinder if the vaporizer has been heated sufficiently.

(k) Close cock on top of cylinder.

(l) Pump two strokes.

(m) Man the fly-wheel by putting one foot on a spoke that is nearly horiziontal and the hand on a rim or a spoke. Start the wheel backward. Bring the wheel around as far as possible, so as to force the piston sharply up against compression. Release the wheel. Explosion should take place, and the engine start forward. Do not attempt to force the crank past dead center.

(n) Take hold of the starting lever, and when the engine has sufficient speed to carry it past compression, throw the lever "TO WORK."

(o) Open the oil feeders. See that the cylinder oil is feeding.

(p) Regulate the pump stroke until *a little oil shows at the overflow.*

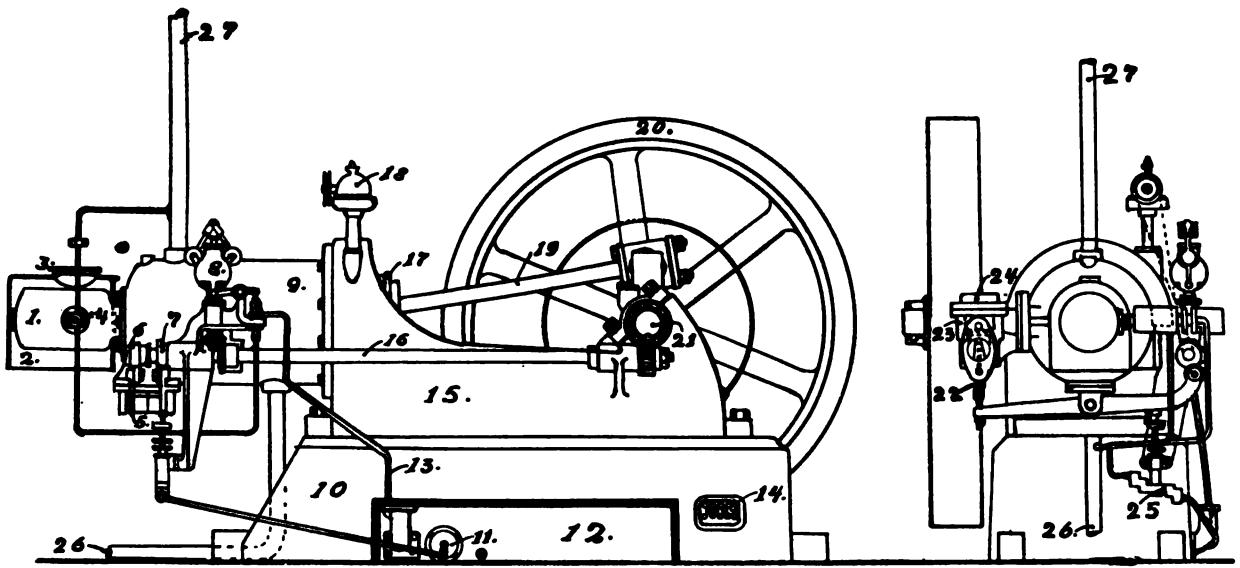
(q) Remove the lamp after the engine has run a few minutes.

(r) Regulate the speed by means of the governor counterweight. To stop, turn hand regulator to "SHUT." When the engine stops, cut off the oilers.

(s) After shutting down, if there is danger of freezing, drain the water from the circulating pipes and cylinder jacket, and the valve box, if water jacketed; otherwise they may burst or crack.

Care of the Engine

Keep the engine clean. Remove all surplus oil that accumulates on the cylinder. Keep all brass parts bright, and iron parts not painted free from rust. The spray nozzle to vaporizer should be cleaned occasionally, as a deposit of carbon here is a common cause of the engine not running well. Keep the water tank, oil reservoir, and oil lubricators filled. Keep the starting lamp filled with oil, and keep the nozzle open, using a small needle provided for that purpose. In frosty weather see that the water is run out as indicated in (s) above.



1. Vaporizer.
2. Vaporizer cover.
3. Vaporizer lid.
4. Oil inlet.
5. Exhaust valve lever.
6. Exhaust valve cam.
7. Air valve cam.
8. Governor.
9. Cylinder casing.
10. Engine base.
11. Filter box.
12. Oil tank.
13. Oil return.
14. Air inlet plate.
15. Bed plate.
16. Cam shaft.
17. Piston.
18. Cylinder lubricator.
19. Connecting rod.
20. Fly-wheel.
21. Crank shaft.
22. Air and exhaust valve springs.
23. Air and exhaust valve box.
24. Air and exhaust valve box cover.
25. Oil pump.
26. Cooling water inlet.
27. Cooling water outlet.

(*b*) *Engine of Casemate 5-kw. Gasoline Electric Set*

Q. Describe the engine of the Casemate 5-kw. Gasoline Electric Set.

A. This engine is a 10-H.P. gasoline engine of the vertical, four-cylinder, four-cycle type, having a bore of three inches and a stroke of six inches, so designed and constructed as to be direct connected to a 5-kw. generator. The full-load speed is stamped on the name-plate, and the no-load speed is within four per cent of that at full-load.

Q. Describe the water colling system.

A. The cooling water for the jackets of this engine may be supplied from a radiating tank or reservoir, from a special automobile type radiator, or direct from the city mains or pressure supply. In the first two cases, the water enters at W-1, passes through the gear pump W, thence to the water jacket, leaving at W-2. (See page 43 for illustration.)

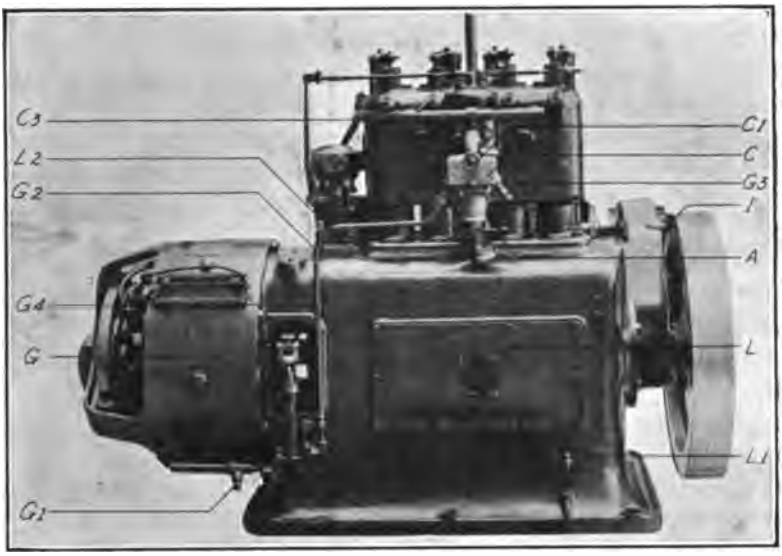
When the cooling water is furnished from a pressure supply, the gear pump should be removed from the engine and a valve placed in the outlet pipe beyond the engine. This will keep the engine jackets full, in addition to regulating the amount of flow. Otherwise, the water system is the same as above described.

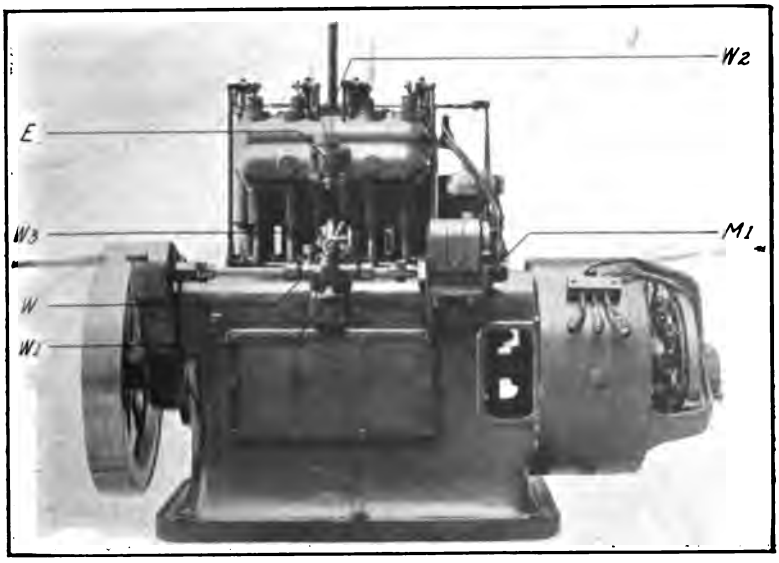
The amount of cooling water should be such that at full load the temperature of the water leaving is between 180 and 190 degrees Fahrenheit. This is not important, but tends to produce the most efficient operation.

When cooling tanks are used they should be so placed that the minimum water level will always be above the pump.

A drain cock should be placed at the lowest point of the supply pipe for emptying the system of water, whenever it is necessary that the engine stand idle during freezing weather. The engine jackets may be drained by the cock at W-3. After water has stopped running from this cock, the engine should be turned backward a few times to empty the water pump. To aid in draining, as well as in filling the jackets, a small air cock should be tapped into the outlet pipe just above the engine. This will allow the passage of air to and from the system. Each time the engine is started it is well to open this small cock; and unless water flows from it, the water cooling system should be investigated.

NOTE:—Where a closed cooling system is used, draining in freezing weather may be avoided by the addition of alcohol,





5-Kw., G. E., Gas-Motor (Casemate 5-Kw. Gasoline Electric Set)

in accordance with the usual practice on automobile radiators.

With the exceptions noted in the foregoing, no valves are to be placed in the pipe between the outlet W-2 and the cooling apparatus or waste, as the closing of such a valve during operation would burst the jackets.

Q. Describe the gasoline supply system.

A. The gasoline supply system is so designed that the supply reservoir may be located outside, away from the operating room and below ground. The bottom of the tank, however, should not be more than five feet below the level of the engine bed, and within a radius of thirty feet from the engine. From the supply tank a ¼-inch iron or steel pipe runs to the ¼-inch union at G-1 (p. 43). The gasoline is drawn through this pipe by the pump G; it is then forced to the carburetor C through the pipe G-2. The pump supplies the same amount of gasoline at all loads, the excess at loads below maximum being returned to the reservoir through a 3/8-inch iron or steel overflow pipe connected to the carburetor at G-3. Both the supply and the overflow pipes should be carefully and evenly graded from the engine to the tank. All dips, pockets and siphons are to be avoided. Pipes which are to carry gasoline should have the joints made up with some special gasoline-proof paste. In the absence of any such compound, yellow oxide of lead (litharge) and glycerin will do most satisfactorily.

The gasoline pump is so designed that it may be operated by hand when the engine is idle, being of the spring return type, operated by an eccentric on the cam shaft. This permits filling or priming the carburetor before starting by simply pressing down on the pad G-4.

The carburetor C is of the overflow venturi tube type, having a chamber or pocket to retain sufficient gasoline at a correct level for carbureting. The quality of the mixture is controlled by a needle valve, the handle of which is shown at C-1, as a notched and numbered disc. A spring C-3 retains the needle valve in any set position and also indicates the amount of opening. The needle valve, for ordinary operating conditions, should be opened about ¾ of a turn. (State of weather and quality of gasoline may vary this either way.)

Below the carburetor is a valve, the handle of which shows at A, for controlling the air taken into the carburetor. By this valve the air may be varied from all hot taken from the crank case to all cold from the room, or none at all. The letters "H," "C," and "S" cast on the valve body indicate

the respective positions of the valve handle for the above conditions.

Q. Describe the fly-wheel markings and the indicated positions of the valves or pistons.

A. On the circumference of the fly-wheel are drawn a number of lines, each stamped with its distinguishing marks or title. When the fly-wheel is so turned that these lines come opposite the indicator I, the various positions of the valves or pistons are indicated as follows:

"Top of Cylinder 1 & 4"—1 and 4 pistons top of stroke.

"Top of Cylinder 2 & 3"—2 and 3 pistons top of stroke.

"I.O.1"—Intake Valve opens, Exhaust Valve closes, No. 1 cylinder.

"X.O.1"—Exhaust Valve opens, No. 1 cylinder.

"I.C.1"—Intake Valve closes, No. 1 cylinder.

"Ignition"—Use explained under ignition system.

(When one set of valves is correctly timed, all are, as the cams are rigidly fixed on the shafts and in relation to each other.)

Q. Describe the ignition system.

A. The complete ignition apparatus consists of a low tension magneto, magnetic make-and-break spark plugs, and cables connecting the same. A short circuiting switch is provided for stopping the engine. For complete and detailed instructions of these parts, see the pamphlet on the subject.

The firing sequence of this engine is 1, 2, 4, 3; the cylinders being numbered consecutively from the front, or cranking, end of the machine. The ignition cables running from the magneto distributor to the spark plugs are marked with numbered tags, indicating the number of the cylinder to which they are connected; and the distributor block on the magneto is stamped showing the number of lead for that particular terminal. The advance and retarding of the ignition is obtained by moving the arm M-1, down or up respectively. On the frame of the make-and-break, the lines stamped "S" and "R" indicate respectively the starting and running positions for the arm M-1.

If it becomes necessary to check the timing of the magneto for any cause, the following should be closely observed:

Turn the fly-wheel, watching closely the intake valve of No. 1 cylinder, until the line on the fly-wheel stamped "Ignition" is opposite index I, *after* the intake valve of No. 1 cylinder has closed; see that the smaller pin of the magneto

coupling is in its uppermost position and that the timing arm M-1 is in maximum retard. The make-and-break should be just opening and a white figure "1" should be seen through the window in the distributor block, behind the lead marked "C."

Q. Describe the lubrication system.

A. The crank case of the engine is the reservoir for all lubricating oil and should be kept filled with a high grade of gas engine oil to the height marked on the sight gauge at L-1. The true height of the oil is shown by this gauge only when the engine is idle. From the reservoir, the oil passes through a strainer to a spring return plunger pump, and by it is forced through the sight feed L to troughs passing under the connecting rods. The connecting rod heads are provided with cast fingers which strike into the oil, splashing it to all parts of the engine. Suitable ducts and pockets are provided so that oil is led to all parts. Excess oil drains back to the reservoir to be used again. The sight feed at L furnishes a visible indication of the working of the oil pump.

Oil may be filled into the crank case at L-2.

Parts not automatically lubricated and requiring attention are:

Links on oil and gasoline pumps.

Collar and pivots of governor.

Bearing of magneto (see Magneto Instruction Book).

Grease cups: No. 2 pump grease of the Vacuum Oil Co. has been found very suitable.

Gasoline pump; the hemp packing of this apparatus should be soaked in glycerin, and the wells in the top of the glands should be kept filled with the same liquid.

Q. Explain how to start the engine.

A. 1. Fill the carburetor chamber by hand operation of the gasoline pump.

2. Check needle valve and set air valve handle A about four notches from "S."

3. Open short circuiting switch and set magneto timing lever at "S."

4. Crank the engine. This should be done by "spinning." *Always* start the spinning operation by *pulling up; never push down.*

Q. After the engine has started, what must be done before it is ready for load?

A. After the engine has started, turn air valve handle

around between "H" and "C," and advance the ignition to the running position. The engine is now ready for load.

Q. How do you stop the engine?

A. To stop, close the short-circuiting switch.

Q. What should be especially noted in the care of the engine?

A. It is well to take part of the carburetor air from the crank case at all times, as this keeps the oil vapors from leaking through the bearings, etc., into the room.

Whenever the various pump glands are repacked or tightened, the gland nut should be screwed down *tight;* then *loosened* a turn or two. This pushes the packing well into place, while not permitting excessive pressure during operation.

When tightening the main bearings, if the two halves of the linings are kept in the same position, no trouble will be experienced in aligning the shaft, as nearly all the wear comes on the lower half of the lining. In order to insure the replacement of the linings in their correct positions, on an edge of each lining is stamped a number, indicating its proper place. These numbers are upright when read from the exhaust side of the engine.

When starting on cold mornings, it will be found necessary to give much more gasoline than when under ordinary conditions; and, in this connection, the fact that liquid gasoline drips from the carburetor does not necessarily imply that the mixture is too rich in gasoline.

Whenever it is thought necessary to regrind the exhaust valve, it should first be carefully cleaned with gasoline; and when the valve is clean it will often be found that grinding is not necessary.

Q. Describe the "Governor Tramel," its purpose, and use.

A. A small 4-inch rod with ends pointed and bent down similar to a U shape is furnished for checking the setting of the governor rod. This instrument is stamped with the words "Gov. Tramel" and the number of the set. Small prick-punch holes are made in the top of the governor rod and in the heads which screw on to this rod, one of which works in the throttle lever and the other in the governor lever. If these heads are ever removed from the rod, they should be replaced in such position that the two prick-punch holes are at just the right distance from the points of the tramel to set in them. This insures the throttle being in correct position when connected to the governor.

GENERATORS

Q. What generators are used in the mining casemate?

A. The generators now used in the mining casemate are: a direct current shunt-wound generator, driven by a four-horse-power oil engine, (or a direct current compound wound generator direct connected to a 10 H.P. gasoline engine) used to charge the casemate storage battery and known as the casemate generator; and two motor-generator sets, the motors of which may be run either from post power or from the casemate storage battery.

Q. Describe the generators of the motor-generator sets.

A. The generator of each motor-generator set is an alternating current generator, run by a direct current motor on the same shaft. It supplies the alternating current necessary to fire mines. The second set is supplied for use in case the first breaks down.

The principal parts of the generator of a motor-generator set, are:—The armature, brushes and holders, commutator for D. C. motor, collecting rings for A. C. generator, field coils or poles, frame and baseplate. The generator should be kept clean and dry. If the casemate is damp, it may be necessary to take special precautions against dampness, wiping off the moisture as far as possible and drying out the casemate with an oil stove, if other means of heating have not been provided. When moisture is present it is well to run the generator, as this will help to dry the machine.

Q. What should be especially noted in the care and operation of the casemate generator of the oil engine set?

A. The belt between the oil engine and the casemate generator should not be too tight. The generator should be fastened to a firm foundation with anchor bolts, and should be well insulated by using a layer of dry wood between the concrete and baseplate. The best dynamo oil should be used for the bearings. Commutators should be clean and smooth, and the brushes should fit on them with large contact surfaces. The commutators should be cleaned occasionally with a little paraffin on canvas. The machine should run smoothly, without any unusual noises and without undue heating of its bearings on account of friction. The armature of the casemate generator of the oil engine set is not well ventilated and it heats unduly. The machine must be carefully watched and on the first sign of undue heating the generator should be

stopped and allowed to cool. Water should never be poured on it to cool it. The brushes should be so adjusted that, when running at full speed, no sparking occurs.

The best position of the brushes is found by trial, and the position should then be marked so that, if disturbed, they can be put back in place readily. The machine should be covered when not in use. All electrical connections should be clean and firmly made.

Q. Describe the generator of the 5-kw. Gasoline Electric Set.

A. The generator of this set is of the multi-polar type, is designed to run at a speed of 750 revolutions per minute, and when so running to generate 40 amperes at 125 volts continuously.

The magnet frame is of cast steel and is made in one piece, so constructed as to be bolted to the engine frame. The magnet cores are of cast steel of high permeability and bolted to the magnet frame. The armature core consists of sheet iron laminations assembled on a spider of cast-iron. The space blocks in the core form air ducts which communicate with the interior of the armature and insure thorough ventilation of the core windings.

The armature winding is of the series drum barrel type.

Care should be taken to see that all connections, both between the coils and on terminal boards, are made as tight as possible in order to reduce the contact resistance to a minimum.

The generator is compounded flat for 120 volts no-load and 125 volts full load, allowance being made for four per cent drop in engine speed. Where necessary a German silver shunt is provided in order to give the correct compoundings.

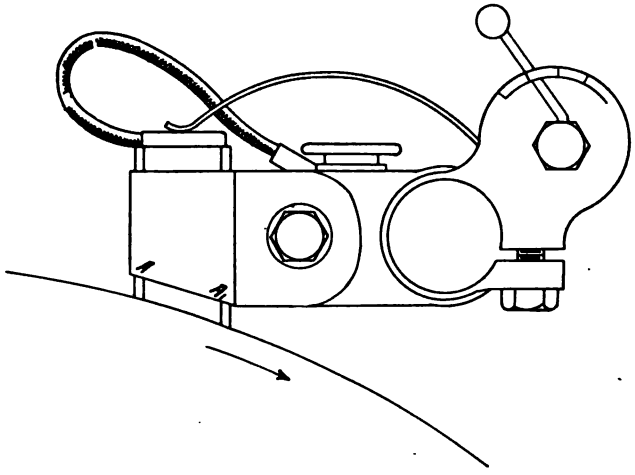
Q. Describe the setting of the brushes of the 5-kw. set.

A. The direction of rotation of these machines is counter-clockwise when facing the commutator end, and the brushes are always arranged so that they trail with reference to the rotation of the commutator. The nuts on the brush holder studs should be tightened up so that studs will be held perfectly rigid; then clamp the body of the brush holder firmly on the stud with the lower edge of box 3/32-inch from the surface of the commutator. Care should be taken to see that the lower side of the box is parallel with the surface of the commutator; in other words, the distance of the point A from the commutator should be the same as that of the point A_1. Also, be careful to see that the brushes are staggered; that

is, that the brushes on any one stud do not follow exactly behind those on the next stud ahead. The brushes should then be inserted in the boxes, properly sandpapered and fitted to the surface of the commutator.

The brushes should be properly spaced by placing a paper ring around the commutator marked with equal spaces to correspond to the number of poles.

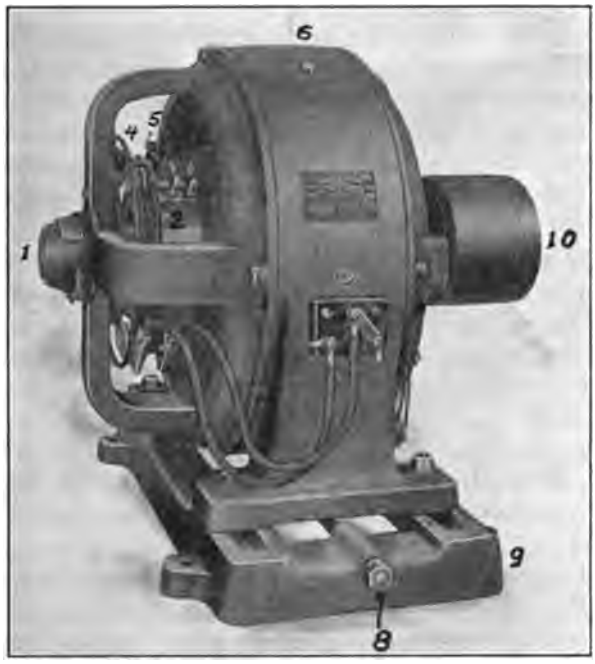
The pressure of the brush should be from ¾ to 1 pound, and can easily be adjusted by placing the adjusting lever in one of the various notches. Nothing is gained by increasing the pressure per square inch on a carbon brush above two pounds, as the resistance per square inch beyond this point is prac-

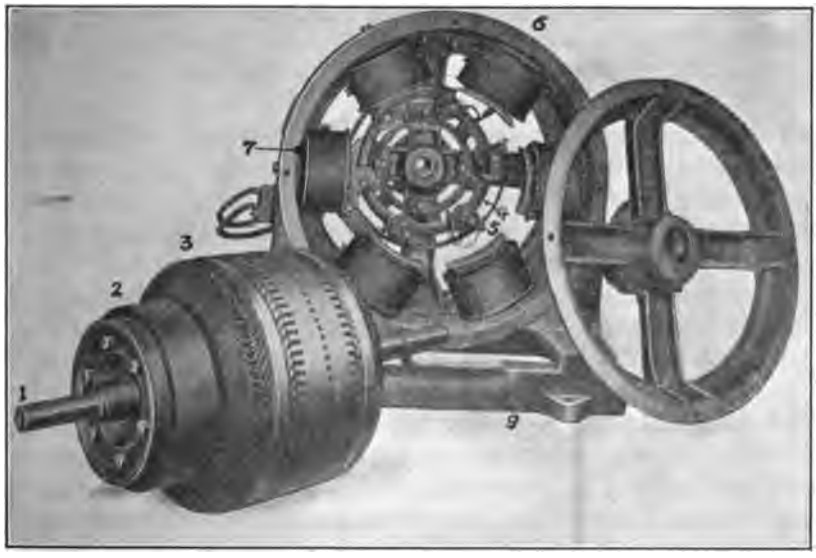


CARBON AND BRUSH HOLDER, CASEMATE 5-KW. GASOLINE ELECTRIC SET

tically not reduced, whereas the friction is increased in direct proportion to the pressure.

Fit the carbon brushes carefully to the commutator by passing beneath them No. 0 sandpaper with the rough side against the brush and the smooth side held down closely against the surface of the commutator. Move the sandpaper in the direction of rotation of the armature and draw it back for the next cut with the brush raised to free it of sandpaper; then lower the brush and repeat the operation until a perfect fit is obtained. If the brush requires considerable sandpapering, No. 2 sandpaper may be used at first, but the final fitting should be done with No. 0. If an attempt be made to fit the brushes without raising them while drawing the sandpaper back, it will in every case fail to give satisfactory results.





D. C. Shunt-Wound Generator for Oil Engine

1 Shaft.
2. Commutator.
3. Armature.
4. Rocker-arm
5. Brushes and brush-holder.
6. Frame.
7. Field Coils
8. Belt Tightener.
9. Base Plate.
10. Pulley.

Across the brush holder yoke is chiseled a line. This line is to come just under the arrow on the right hand side of the upper arm of the bearing bracket. When this is the case, the brushes are in the correct position, and the generator will compound according to the nameplate stamping. No movement of the brushes is necessary for variations of load.

Q. What should be especially noted in the care of the commutator of the 5-kw. set?

A. The commutator, brushes and brush holders should at all times be kept perfectly clean and free from carbon, or other dust. Wipe the commutator from time to time with a piece of canvas lightly soaked with vaselin; if vaselin is not at hand, use oil; but lubricant of any kind should be applied very sparingly.

If the commutator, when running, begins to give trouble by roughness with attendant sparking or excessive heating, it is necessary immediately to take measures to smooth the surface. Any delay will aggravate the trouble and eventually cause high temperatures, throwing of solder and possible displacement of the segments. No. 0 sandpaper fitted to a segment of wood with a radius equal to that of the commutator, if applied in time to the surface when running at full speed (if possible with the brushes raised) and kept moving laterally back and forth on the commutator, will usually remedy the fault. If this does not suffice, it will then be necessary to take armature out, tighten up the segments and turn them off true. A machine tool will not leave the surface smooth enough to give perfectly satisfactory results. It is always necessary, before putting on a load after commutator has been turned, to carefully smooth the surface with the finest sandpaper, thus removing all traces of the tool point.

The outboard bearing should be filled with the best grade of thin lubricating oil, being careful not to allow it to overflow. Oil throwing is usually due to excess of oil and can be avoided by care in filling the oil reservoir. This bearing should be examined at least once a day while the machine is in operation, to see that the oil rings are turning properly and that there is sufficient oil in the reservoir. When it is necessary to renew the oil, draw the old oil out from the reservoir by means of the oil plug in the shield.

TRANSFORMERS

Q. Describe the casemate transformer.

A. It consists of two coils of wire wound around a laminated iron core and insulated from each other and the case containing them. The wires that lead from the generator are called primary, and those that lead to the power panel, secondary. The case is filled with transformer oil to keep this core and coils cool and it also serves as insulation.

Q. What is its use?

A. It is used to "step-up" the A.C. voltage from the motor-generator; that is, to increase it from 80 to 500 volts.

Q. What care should be taken of the transformer?

A. It should be kept filled with transformer oil. This insulating oil should not touch the primary wires above the coil, otherwise the transformer will leak.

Storage Batteries

Q. Name the batteries used in mine work.

A. Casemate storage battery, consisting of forty (40) cells. Testing battery, consisting of 2 or 3 dry cells, to be used for testing during the preparation of the mines. Dry cells may be used with the boat telephone in the casemate.

Q. Describe the casemate battery.

A. This is a forty cell "Chloride Accumulator" with a normal charge and discharge rate of 5 or 15 amperes according to installation. The voltage may be taken at 2 volts per cell. The type of the 5-ampere cell is D-5, in which the letter denotes the size of the plate, and the figure the number of plates per cell. A similar designation is used for the 15-ampere cell. In the type used for the submarine mine work, there are two positive plates and three negative plates in each cell. The positive plates are of a brownish color—sometimes called plum colored. The negative plates have a grayish color. When the battery is set up, the cells rest on sand trays and the trays on glass insulators. This is to thoroughly insulate the battery. The jars are filled with electrolyte, which is a mixture of sulphuric acid and water, having a specific gravity of 1.200.

Q. What is the use of the casemate storage battery?

A. This battery supplies direct current for testing mines and cable ends, for signalling purposes when a mine is struck, for running the motor of the motor-generator set, and for lighting the casemate.

Q. What precautions are necessary to keep the casemate storage battery in order?

A. Never continue the discharge below 1.75 volts per cell at full load—at a rate of five or fifteen amperes according to type of cell. In ordinary service it is better to stop the discharge at 1.9 volts. Begin charging immediately when the battery is discharged. For a regular charge, continue until the specific gravity is about 1.207 per cell.

If the battery is discharged daily, give it an over-charge once a week by charging until the specific gravity is about 1.210 per cell, and there is no further rise for five successive 15-minute readings. When the battery is but little used, freshen it up regularly, and give it an over-charge once in two weeks. At the end of a regular charge, the cells gas moderately; at the end of an over-charge, freely.

Keep the electrolyte at from ½ to ¾ inch above the plates. Add distilled water to bring the cells to the proper height before the over-charge. It will be necessary to add electrolyte only at long intervals to replace any loss.

Daily readings of the specific gravity and voltage should be taken from a cell called the pilot cell. These should be recorded. If the battery is new and in good condition, the readings from this cell may be taken to indicate the condition of the battery. Weekly readings are taken from each cell of the battery. The specific gravity is taken the day before the over-charge and the voltage is taken near the end of the charge. Voltage readings must always be taken when the current is flowing. The above readings should be recorded.

Inspect each cell carefully the day before the over-charge. A battery inspection lamp is provided for this purpose. See that no foreign substance is lodged between the plates; if so, remove it or push it down to the bottom of the jar by means of a piece of wood or hard rubber. Never use any metal for this purpose. See that the sediment at the bottom of the jar does not reach to the plates. If this condition occurs, report it.

If any cell is abnormally low at the end of the charge, report the fact immediately. If it is necessary to use the battery at once, cut this cell out on the discharge. Low cells are generally caused by short circuit in them, due to scale or foreign matter between the plates.

Keep the battery room well ventilated, especially while charging. Do not enter the room with an exposed flame during or shortly after the gassing period of the charge.

Keep the jars, sand, trays, table, etc., clean; also, keep all connections bright and clean.

Keep the floor and other parts of the battery room clean. If any unusual condition arises, report it immediately.

SEARCHLIGHTS

Letters in illustration of "Parts of Lamp Mechanism" (see page 56) refer to parts as follows:

A Negative carbon holder.
B Positive carbon holder.
C Clamping screws for carbon clamps.
D Vertical adjusting screw for positive carbon clamp.
E Horizontal adjusting screw for positive carbon clamp.
F Negative carbon support.
G Positive carbon support.
H Lamp frame.
K Main lamp contact shoes.
L Hand feed screw.
M Fixed nut for focusing screw.
N Stud of lamp switch for cutting out feeding magnet.
O Ratchet and pawl.
P Feeding magnet armature.
Q Contact of circuit breaker.
R Adjusting screw for ratchet arm.
S Starting magnet.
T Feeding magnet.
U Adjusting spring for feeding magnet.

Q. Describe a searchlight.

A. The principal parts of a searchlight are: The lamp, reflector, drum, lamp box, glass front door, standards, turn-table, pedestal, and training mechanism.

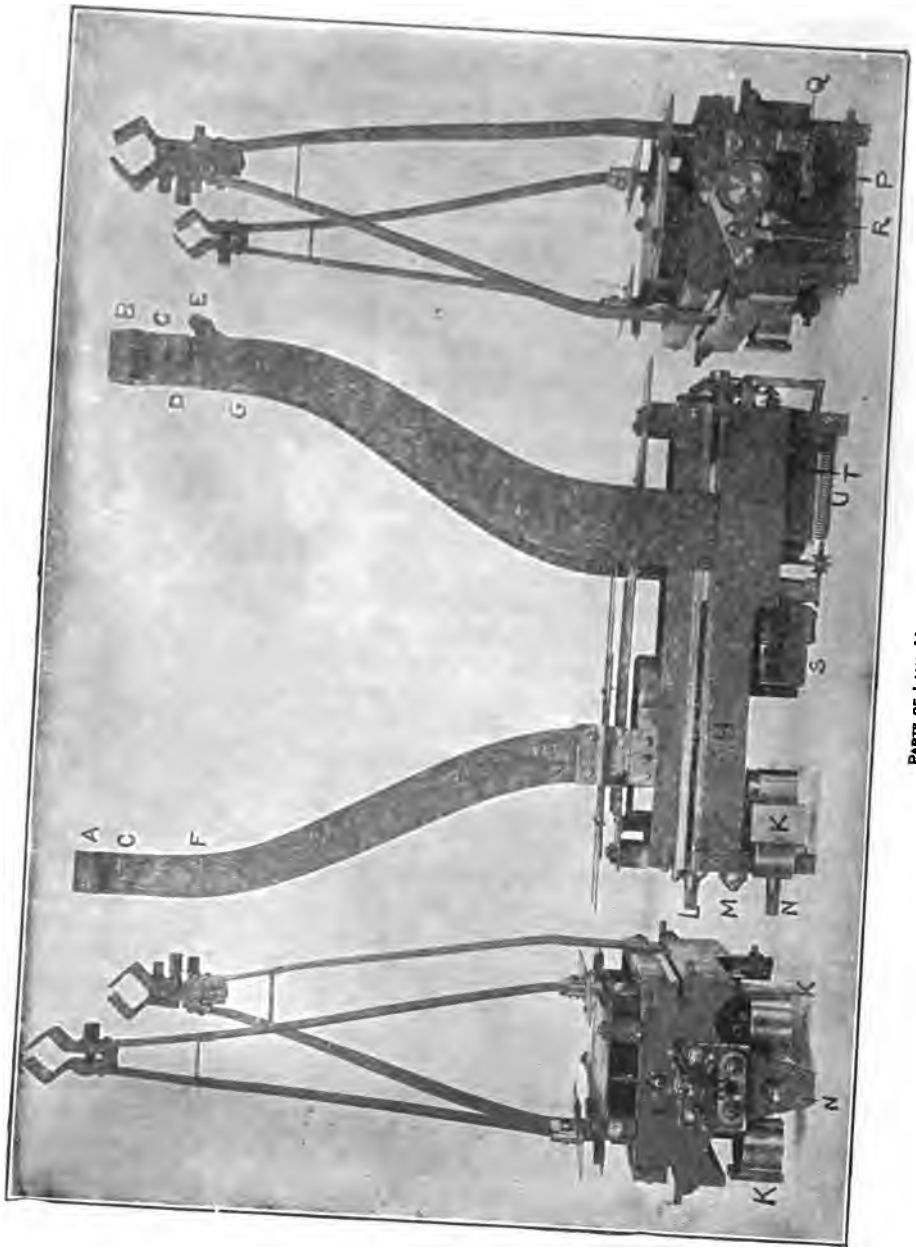
The lamp is for producing the light, and consists chiefly of a pair of carbons and a starting and feeding mechanism to form and maintain the arc. The reflector is a parabolic mirror which projects the light in a beam whose rays are sensibly parallel.

The drum and lamp box are together a casing for the lamp and reflector.

The lamp rests on guides fastened to the lamp box and may be moved forward or backward by turning the focusing screw.

The glass front door is for the protection of the lamp and mirror.

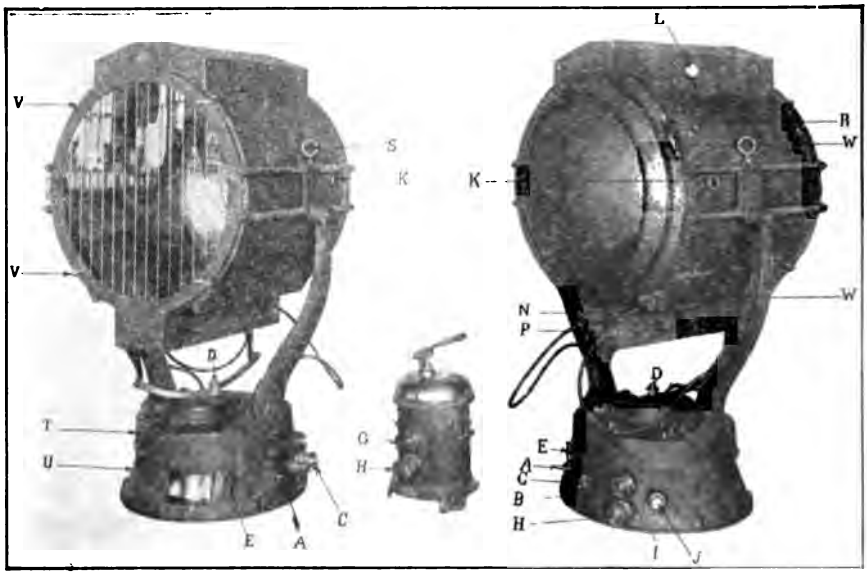
The drum rests on trunnions which bear on standards which are bolted to the turn-table. The turn-table rests on rollers



PARTS OF LAMP MECHANISM

on top of the pedestal. It is thus seen that the drum may be moved vertically or horizontally. This may be done by hand or electrically.

The electrical control mechanism consists of two motors located on the pedestal and connected electrically with the



OLD STYLE PROJECTOR AND CONTROLLER, 6-WIRE

A SHAFT FOR SLOW VERTICAL MECHANICAL TRAINING.
B ECCENTRIC FOR THROWING OUT HORIZONTAL TRAINING GEAR.
C SHAFT FOR SLOW HORIZONTAL MECHANICAL TRAINING.
D CLUTCH FOR THROWING OUT VERTICAL TRAINING MECHANISM FOR QUICK HAND CONTROL.
E MAIN LAMP SWITCH.
F CONTROLLER HANDLE.
G CONTROLLER FUSE BLOCK.
H RECEPTACLE FOR CONTROLLER CABLE COUPLING.
I RECEPTACLE FOR MAIN LINE CABLE COUPLING.
J RECEPTACLE FOR MOTOR WIRE.
K SIDE PEEPSIGHT.
L VERTICAL PEEPSIGHT FOR OBSERVING IMAGE OF CRATER.
N SOCKET FOR INSERTING WRENCH FOR FEEDING LAMP BY HAND.
O FOCUSING SCREW.
P SOCKET FOR INSERTING WRENCH TO OPERATE FEEDING MAGNET SWITCH
R DOORS FOR ADJUSTING LAMP.
S CLAMP FOR ADJUSTING BALANCE OF DRUM.
T TURNTABLE.
U PEDESTAL.
V LATCHES FOR SECURING GLASS FRONT DOOR.
W HANDLES FOR CONTROLLING BEAM BY HAND.

controller in the mine commander's station, from which the light may be trained with different speeds either horizontally or vertically.

Q. What are the uses of the mine light?

A. It is used to illuminate any target assigned to the rapid fire batteries of the mine command, also, to search for

and illuminate any boat which may be operating to destroy or render harmless the planted mines.

Q. What are the principal points in the operation and care of the searchlight?

A. *To operate light.* Separate the carbon holders as far as possible. Secure the carbons in their holders with the negative one, *i.e.*, smaller one, nearest the mirror. The carbons should be in prolongation of each other. Adjusting screws on the carbon holders are provided for aligning the carbons.

Move the carbon tips approximately in focus by means of the focusing screw; a line will be found inside of the drum by which the focus may be located.

See that all the resistance is in the rheostat, *i.e.*, that the handle is to the left, and that the voltmeter indicates that there is sufficient power on the mains.

Turn on the power to the lamp by means of the lamp switch. The carbons will feed together and strike the arc. In case the automatic feed does not work, use hand feed.

See that the lamp is in focus by observing the image of the crater in the vertical peep sight.

See that the current in the 36-inch light is about 130 amperes, and voltage across the arc about 60 volts. If both are lower than these values, cut resistance out of the rheostat.

Do not elevate the drum so that red hot particles of carbon will fall on the mirror. The safe limit is about 30 degrees above the horizontal. Should the lamp go out, open the lamp switch immediately.

To contract the beam, move the arc away from the mirror; to spread the beam, move it toward the mirror. Observe the arc through the peep sight and see that it is kept centered. When hand feed is used, regulate the arc so that the current and voltage are normal and constant. In case smoke arises from the training mechanism, power should be immediately shut off.

To put the lamp out of action, open the lamp switch.

Care of the lamp. The lamp should be removed from the drum from time to time, cleaned, and the bearing surface well oiled. Carbons should be kept in a clean, dry place, and free from grease, water, and other impurities. Baking the carbons in an oven before using will insure good results. The mirror should be kept dry. Before using, dust with a soft brush or cloth, and then clean with chamois skin. Alcohol may be

used to remove dust and oil from the mirror, afterward polish it with a clean, soft cloth, or chamois skin.

The electrical training mechanism should be kept free from dirt and rust. The bearings should be kept clean and well oiled. The relay contacts should always be clean and bright.

(e) OPERATION OF THE CASEMATE APPARATUS AND OF TELEPHONES

Casemate Apparatus

Q. Point out the apparatus of the power panel.

A. Mil-ammeter; double pole circuit-breaker, switch for lamps at top of board; reverse current circuit-breaker; A.C. voltmeter receptacles; ammeter; A.C. voltmeter; D.C. voltmeter; D.C. voltmeter receptacles; battery rheostat; D.C. power switch; field rheostat; a row of switches for distributing power from the D.C. busses; a row of switches for distributing power from the A. C. busses; a switch for testing fuses.

Q. Point out the apparatus of the operating board.

A. Signal block with bell, bell switch, lamps and terminals; master block, with firing switch and testing switch; mine block, with mine switch, power switch, solenoid, automatic switch, testing switch; terminal block for mine conductors.

Q. How do you energize D.C. busses?

A. From generator:
Close single pole circuit-breaker.
Close No. 2 to left.
From post power:
Close single pole circuit-breaker.
Close No. 2 to the right.
From storage battery:
Close double pole circuit-breaker.
Switch No. 2 should be open.

Q. How do you charge battery from generator?

A. Close single and double circuit-breakers.
Close No. 2 to left.

Q. How do you test the D.C. voltage?

A. Plug in at proper receptacle and read the voltmeter.

Q. How do you test A.C. voltage?

A. First see that all automatic switches are up, all firing switches open, and A. C. operating switch No. 8 open.
Close:
(a) Double pole circuit-breaker, to energize D.C. busses. No. 4 up.
(b) Starting switch of motor generator.

(c) No. 9 up (when motor generator is up to speed).
(d) Plug in A.C. voltmeter.
Regulate battery rheostat to bring voltage to 500.

Q. How do you make test for insulation of mine circuit?
A. Put D.C. on D.C. busses of power panel.
Close switch No. 7 up.
Open power switch on mine block.
Put M.A.M. plug on upper point of power switch.
Result: M.A.M. should read 30-40 mil-amperes.

Q. How do you test automatic switch, red lamp, and bell?
A. With D.C. on busses of power panel,
(a) Close No. 3 up.
Open bell switch.
Close testing switch on mine block down.
Result: Red lamp should glow and automatic switch trip.
(b) Close bell switch.
Result: Bell should ring.

Q. How do you test the alternating circuit?
A. With D.C. on busses of power panel,
(a) Connect A.C. and D.C. jaws on master block with a jumper.
Close Nos. 3, 8 and 9 up.
Result: Green and white lamps on operating board should glow normally.
(b) Open Nos. 3, 8 and 9.
Close No. 7 up.
Remove jumper.
Put M.A.M. plug on A.C. jaw of master block.
Close firing switch.
Trip each automatic switch in turn.
Result: M.A.M. should read 30-40.
(Caution: Close each automatic switch before tripping next one.)

Q. How do you test for delivery of A.C. to the operating board?
A. *Have all automatic switches up and all firing switches open.*
Close Nos. 4 and 9 up.
Close No. 8 down.
Close testing switch (T.S.) on master block.
Result: White lamp should glow. A.C. voltage drop.

Q. How do you test the power?

A. Place two fuses in multiple across the fuse leads from the power panel.

Put these fuses in the place provided outside of casemate.

Open all switches on power panel.

Have all automatic switches up.

All firing switches open.

Energize D.C. busses on power panel.

Close No. 4 up and start the motor generator.

Close No. 9 up.

Close No. 12 up.

Close No. 11 up.

Result: The fuses should explode.

Q. How do you fire a mine in observation firing?

A. At the command "Observation firing," the operator sees that,

All automatic switches are up.

All firing switches are open.

Close double circuit-breaker.

Close switches Nos. 4 and 9.

At the command "Group — Mine —;"

Close switches Nos. 3 and 8.

At the command "Ready,"

Stand ready to trip the proper automatic switch.

At the command "Fire,"

Trip the automatic switch, and close it down tight.

Close the firing switch.

After the mine is fired,

Open firing switch.

Open power switch.

Close up automatic switches.

Open mine switch.

If automatic switch falls before the command "Fire," fire the mine by closing firing switch, unless there are positive orders to the contrary.

Q. What is done in the casemate when firing on contact?

A. At the command "Contact firing," the operator sees that,

All automatic switches are up.

Power and mine switches closed.

Firing switches open.

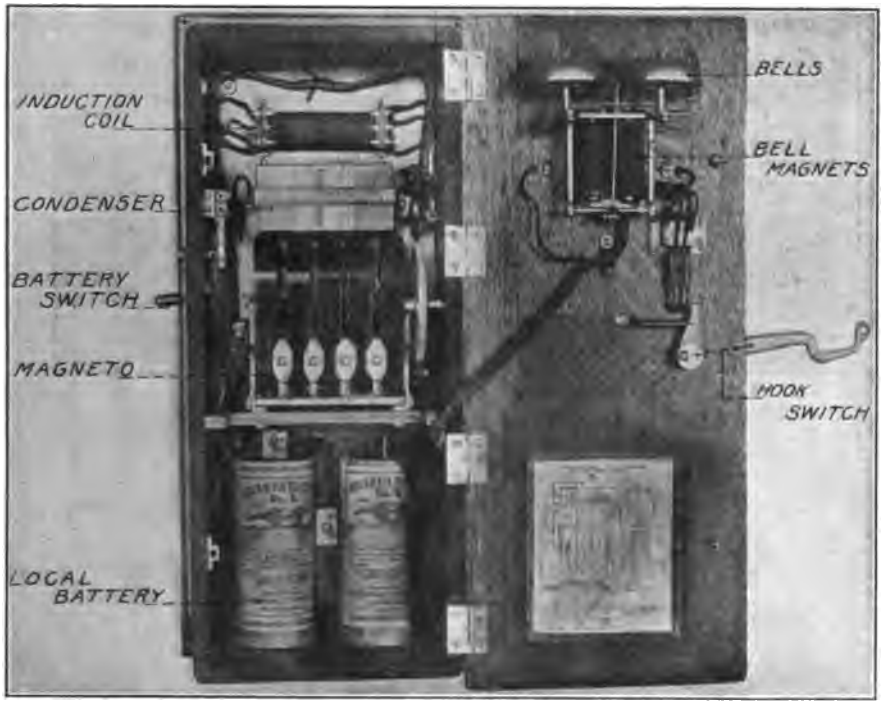
Close double circuit-breaker and Nos. 4, 9, 3 and 8.

Close firing switches on all operating boards or on such as were indicated.

When a mine is fired, the mine block for this mine will be cut out by opening power switch, closing up automatic switch, and opening mine switch.

If the command be "Delayed contact firing," the operations are as above, except that the firing switch is closed by the operator a short time after the automatic switch falls or when he is directed to do so.

After firing, the firing switch is opened and the mine block cut out as above.



COMPOSITE ARTILLERY TYPE TELEPHONE

THE TELEPHONE

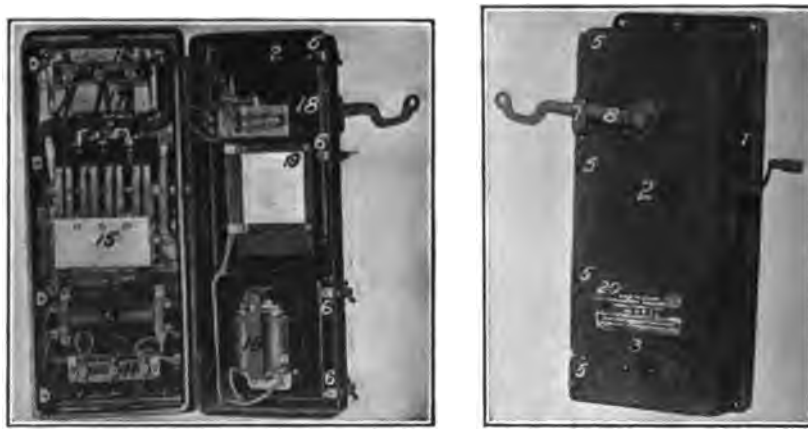
Q. How does the casemate communicate with the D. B. boat?

A. By means of what is called a boat telephone. The simplest form of such a telephone consists of a hand set, which combines a receiver and transmitter.

At the D. B. boat one of the telephone terminals is connected with a conductor of the multiple cable; the other with the cable armor or an earth plate.

At the casemate an eight or ten volt battery has one terminal connected to earth; the other battery terminal is connected with one telephone terminal; the other telephone terminal is connected with the same conductor of the multiple cable, to which the telephone is connected at the D. B. boat end.

Q. What is the telephone?



COMMON-BATTERY ARTILLERY TYPE TELEPHONE

1. METAL CASE, COMPLETE.
2. METAL CASE, DOOR FOR.
3. METAL CASE, METAL PLATE FOR PROTECTING GONGS OF RINGER, COMPLETE
4. SCREW FASTENER, INTERNALLY THREADED.
5. WING BOLT FOR FASTENING DOOR.
6. ANGLE PIECE FOR SUPPORTING WING BOLT.
7. HOOK, STOP.
8. HOOK, COMPLETE.
9. HOOK RETAINER.
10. HARD-RUBBER STRIP WITH 3 WING-NUT BINDING POSTS, LINE.
11. HARD-RUBBER STRIP WITH 3 WING-NUT BINDING POSTS, TALKING SET.
12. WING-NUT BINDING POST, COMPLETE.
13. INDUCTION COIL.
14. INDUCTION COIL, TERMINALS FOR.
15. GENERATOR.
16. RINGER.
17. CONDENSER.
18. SWITCH, HOOK, COMPLETE.
19. PLATE, CIRCUITS.
20. NAME PLATE, DIRECTION.

A. A telephone is an instrument by means of which a sound produced at one end of a wire is reproduced at the other end.

Q. What two types of telephone are used in the Coast Artillery service?

A. The "composite artillery type" and the "common battery artillery type."

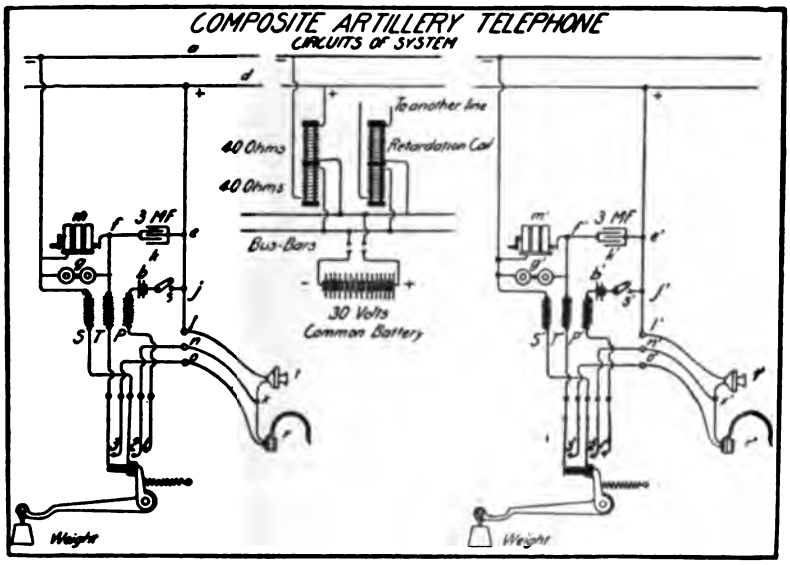
Q. What is the chief difference between the two types?

A. In the composite type use may be made of either a

common or local battery; while in the common-battery type only a common battery is used.

Q. What are the two classes of telephone "sets" in artillery work, and how are they used?

A. "Auxiliary sets" and "talking sets," so arranged that any of the talking sets can be used with an auxiliary set to make up a complete telephone. The auxiliary set contains



Talking circuit: + bat., bus bar, retardation coil, + line, + binding post, e, j, l, t, x, n, contact 2, S, − line, retardation coil, bus bar, − bat.

Hearing circuit: T, f, k, e { j, l, t, - - - - - - - - - - - + line, e' { k', f', T', 3', o', r' / j', l', t' - - - - - } - - - - - - - - - x', n', 2', S', − line, S, 2, n, } x, r, o, 3, T.

Ringing circuit: m, f { g - - - - - - - - - - - - - k, e, + line, e', k', f', g', − line, m }

all the local parts of the telephone proper, except the receiver and transmitter. The talking sets are the receiver and transmitter made up in different forms for different kinds of service.

Q. Name the different auxiliary sets.

A. Of the composite type: wall set; *plotter's set;* battery commander's set; protable set; and gun set.

Of the common-battery type: wall set; battery commander's set; portable set; and gun set.

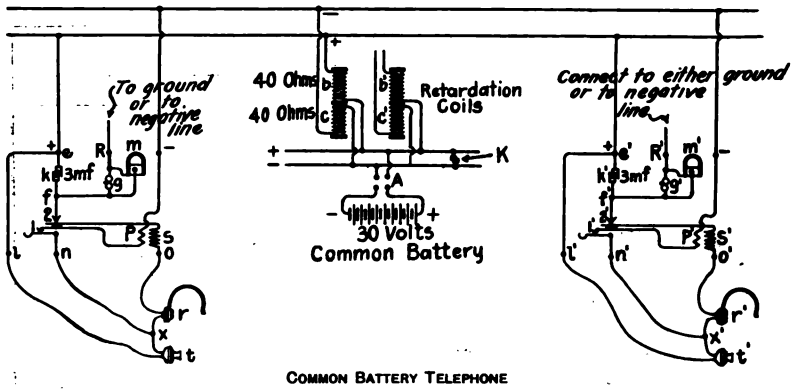
Q. Name the different talking sets.

A. The head set, hand set, and desk set.

Q. What supplies the energy to operate the telephone?

A. Composite type: a central storage battery located in the switchboard room; or a local battery of two dry cells located inside the telephone.

Common-battery type: a central storage battery located in the switchboard room.



COMMON BATTERY TELEPHONE CIRCUITS OF SYSTEM

Talking circuit:

+ bat., + bus bar, retardation coil b, + line, + binding post, e, l, t, x, n, hook switch contact 1, P, − binding post, − line, retardation coil c, − bus bar, − bat.

Hearing circuit:

Distant

S, hook switch contact 2, f, k, e, + line, e′, k′, f′, hook switch contact 2′, S′, o′, r′, x′, n′, hook switch contact 1′, P′, − binding post, − line, − binding post, P, hook switch contact 1, n, x, r, o.

Local

S, hook switch contact 2, f, k, e, l, t, x, r, o.

Ringing circuit:

Distant

Magneto m, R, through ground or negative line R′, g′, f′, k′, e′, + line, e, k, f, m.

Local

Magneto m, through g to magneto.

Q. What other telephones obtain current from the same central storage battery?

A. All the other telephones in the same fort command.

Q. What is the voltage across the terminals of the central storage battery?

A. 30 volts.

Q. Are these dry cells in the telephone now?

A. No; they are furnished only in time of war for use when the central storage battery fails.

Q. Point out the battery switch (*of the composite type only*).
Q. What is its use?
A. It makes and breaks the local battery circuit.
Q. Upon which post should it be left?
A. Upon the post marked "Common Battery."
Q. How many circuits are there in this telephone?
A. Three: the primary, or talking circuit; the secondary, or hearing circuit; and the ringing circuit.
Q. Trace the primary circuit.
Q. What part does this circuit pass through?
A. The transmitter, the induction coil, the retardation coil, and the hook switch.
Q. Point out the transmitter.
Q. What is its function?
A. The transmitter causes the strength of the current in the primary circuit to fluctuate whenever sound waves fall upon its diaphragm.
Q. Point out the induction coil.
Q. What is its function?
A. The induction coil induces an alternating current in the hearing circuit in unison with the fluctuations in the talking circuit current.
Q. Point out the retardation coil.
Q. What is its use?
A. It prevents the talking or ringing on one line from being heard on the other lines in the fire command.
Q. Point out the hook switch.
Q. What is its use?
A. It breaks the local circuit when the receiver is up, thus preventing the storage battery from running down. It also breaks the secondary circuit and allows the bells to be rung.
Q. Point out the line terminal posts.
Q. Trace the local branch of the hearing circuit.
Q. Trace the line branch of the hearing circuit.
Q. What parts are in the hearing circuit?
A. The receiver, the induction coil, the condenser, the transmitter and the hook-switch of both the local and distant phones.
Q. Point out the receiver.
Q. What is its use?
A. The object of the receiver is to reproduce sound waves when its coils are energized by the alternating current in the hearing circuit.

Q. Point out the condenser.

Q. What is its function?

A. It prevents the direct current from the storage battery from flowing through the bell and the generator. It also makes the talking more distinct.

Q. Trace the ringing circuit.

Q. What parts are in the ringing circuit?

A. The generator, the bell, and the condenser.

Q. Point out the generator.

Q. What is its function?

A. By turning the generator crank, the armature is revolved and an alternating current is generated which rings the bells.

Q. Point out the bell.

Q. What are its functions?

A. It rings to notify the operator that he is wanted.

Q. Point out the terminal posts for the head set.

Q. How can you tell which wire should be attached to each post?

A. The wires are of different colors and the terminal posts are labeled with the corresponding colors.

Q. What different kinds of composite artillery type telephones are there?

A. The wall telephone, the plotter's telephone, the gun telephone, the battery commander's telephone, the desk telephone, and the portable telephone.

Q. Tell how to open station.

A. (a) Take the head set or retaining spring off the hook and put on the head set.

(b) See that the connections are tight. These include the two connections to the line and three for the head set.

(c) Lower and raise the hook. A sharp click should be heard. A slight scratching in the transmitter should be heard in the receiver.

(d) Call the name of the distant station.

(e) To ring up the distant station, hold the hook down and turn the generator handle. Release the handle to converse. If any hooks on the line are up, none of the distant bells will ring.

Q. How is the station closed?

A. Call "close station" to distant station; hang receiver on hook or attach retaining spring; wipe off both receiver and transmitter.

Q. What care should be taken of the telephone?

A. Never leave the station with the hook up; keep the nuts on the terminal posts tight and the cords clear of tangles; polish up the outside nickel work once a week; keep the door shut; report trouble in the talking to the station chief.

APPENDIX "A"

EXAMINATION FOR GUNNERS AND FOR SPECIAL RATINGS

EXAMINATION FOR GUNNERS

(Numbers refer to paragraphs in the 1914 Drill Regulations.)

806. Boards of examination will be convened annually in each coast defense command by the coast defense commander, to meet, if practicable, just prior to, or just after the close of the indoor instruction period. Separate boards may be convened for the examination of candidates for first and for second class gunners, and separate boards may be convened for the different forts in a coast defense command. Each board will consist of three coast artillery officers. When a member of the board is a company commander he will be relieved by another officer during the examination of candidates from his company.

807.* For purposes of instruction and examination, enlisted men of the Coast Artillery Corps not belonging to companies or batteries, upon application, will be attached to convenient organizations, and upon qualification will be classified as gunners.

808. A candidate to be eligible for qualification as first-class gunner must have qualified previously as second-class gunner, though both qualifications may be made at the same examination.

809. The examination of gunner candidates will be held, as far as practicable, at such places as the material pertaining to the subject in hand is located, and will be made as practical as possible. In determining the qualifications of candidates, credit will be given for practical knowledge of subjects, rather than for text-book answers to questions.

810. The qualifying mark for classification as first or second class gunner will be in each case not less than an average of 75 per cent. Whenever, during the progress of the examination of a candidate for either grade, the sum of the marks received on subjects for which he has already been examined, increased by the maximum allowed for the remaining subjects, is less than 75, he will be disqualified and his examination will be discontinued. Whenever, during the progress of the examination of a candidate for either grade, the sum of the marks received on the subjects in which he has already been examined is 75 or more, he will be qualified without any further examination.

811. The board will keep a record of its marks during the examination, but these marks will not be published in orders. The report of the board on each company will be sent as soon as practicable after the completion of the examination to the coast defense commander, who will publish an order announcing the names of those who have qualified as first and second class gunners, and the date of qualification (the date of the completion of the company examination being taken as the date of qualification).

812. The scope of the examinations for the first and second class gunners and the relative weights to be given the subjects will be as follows:

* See C. C. A. D. R., Nos. 2, 3, and 4.

* * * * * *

For candidates in companies and detachments assigned to mine defense:
For second-class gunners:

(*a*)	Ammunition, nomenclature, and service of guns to which the candidate's company is assigned	15
(*b*)	Material of and the duties in the loading room (except electrical principles involved)	30
(*c*)	Material for and duties on the water	30
(*d*)	Cordage, gins, shears, and jacks	10
(*e*)	United States magazine rifle	15
		100

For first-class gunners:

(*a*)	Care and preservation of mine material	15
(*b*)	Handling high explosives	20
(*c*)	Knowledge and use of the azimuth instrument and plotting board	20
(*d*)	Engines, generators, transformers, storage batteries, and searchlights assigned to the company of which the candidate is a member	20
(*e*)	Operation of casemate apparatus and of telephones	20
(*f*)	Definitions C. A. D. R.	5
		100

Examination for Special Ratings

813. In each company of coast artillery, examinations will be held by the company commander under the direction of the fire or mine commander, at such times as the latter may prescribe, for the purpose of determining enlisted men who are qualified for appointment to rated positions.

814. Records will be kept in each company in the form of eligible lists for each rated position to which enlisted men of the company may be appointed.

815. Examination for rated positions will be confined to first-class gunners or enlisted men who have once been classified as first-class gunners. Candidates who pass with an average of 75 per cent any of the examinations prescribed for rated enlisted men will be carried on the qualified list for appointment to the corresponding rated position for a period of one year from the date of examination.

816. Enlisted men on the qualified list for a rated position will be classified as first-class gunners from the date of qualification and so announced in coast defense orders, and such classification will be continued for the time they are entitled to remain on such qualified list. When a man's term of qualification for any rated position expires, he may be continued in such rated position or on the corresponding qualified list by passing a new examination for such rated position, and his classification as first-class gunner will be continued without further examination.

817. The same enlisted man may be carried on several eligible lists provided he passes satisfactorily the prescribed examinations for such rated positions.

818. Prior to the examination for the rated positions of observers, first or second class, or gun pointer, the candidates will be examined by the post

surgeon for defective vision, and no candidate will be rated for these positions who has any defect in vision which would impair his efficiency.

819. An enlisted man holding a rated position need not be required to take the examination for that position until the termination of the one-year period from the date of his last classification as a first-class gunner, unless his qualifications for the position he holds have not been established to the satisfaction of the fire or mine commander concerned or the coast defense commander, in which case he will be required to take the examination for that position at such time as may be prescribed by the fire or mine commander concerned. In the event of his failure to pass satisfactorily the prescribed examination, he will be disrated immediately by the coast defense commander.

820. The scope of the examination for each of the rated positions will be as follows:

GUN COMMANDER AND GUN POINTER

I. Definitions C.A.D.R.
II. Gun and carriage.
  (*a*) Nomenclature, purpose, and action of several parts.
  (*b*) Packing stuffing boxes and cleaning recoil cylinders.
  (*c*) Adjustment of—
    Quadrant elevation device, sight standard, throttling valve, gas-check pad, elevating gear, grease cups, and firing mechanism.
  (*d*) Care and preservation, including care of hand counterweights, oiling, and painting.
III. Powders, projectiles, fuses, and primers.
  (*a*) Blending powder and preparation of powder charges.
  (*b*) Filling and fusing projectiles.
  (*c*) Painting projectiles.
IV. Preparations for service or subcaliber practice.
V. Service of the piece.
  (*a*) Duties of each member of the gun section under all conditions.
VI. Precautions for safety at the battery.
VII. Pointing.
  (*a*) Methods of pointing and pointing tests.
  (*b*) The telescopic sight (the quadrant for mortars).
  (*c*) Emergency system and salvo points.
  (*d*) Bore sighting and orientation.
VIII. Regulations governing service and subcaliber practice so far as they affect the service at the emplacements.
IX. Mounting and dismounting guns and carriages.
X. Characteristic features of the several classes of war ships, general knowledge of local shipping, of channels leading to the harbor, and of ranges to prominent fixed objects in the field of fire of the battery.

PLOTTER

I. Definitions C.A.D.R.
II. Position finding system.
  (*a*) Detailed knowledge of system employed at the battery.
  (*b*) Indication and identification of targets.

(c) Duties of each member of the range section under all conditions.
(d) Emergency system and salvo points.

III. Position finding apparatus.
(a) A detailed knowledge of adjustments and use of all position finding apparatus used in the plotting room.

IV. Elementary gunnery.
(a) Explanation of the several corrections to be applied to the observed range to obtain the corrected range.
(b) Effect on the flight of the projectile of variations in the density of the air; the direction and velocity of the wind.
(c) Use of trial shots and application of data obtained from them (problem).

V. Preparation of target-practice records.

OBSERVER (FIRST OR SECOND CLASS)

I. Definitions C.A.D.R.

II. Position finding system.
(a) Detailed description of that in use at the battery.
(b) Indication and identification of targets.
(c) Emergency system and salvo points.

III. Position finding apparatus.
(a) A detailed knowledge of adjustment and use of all observing instruments and range finders in use at the battery.
(b) Use of the telephone.

IV. Characteristic features of the several classes of war ships, general knowledge of local shipping, of channels leading to the harbor, and of ranges to prominent fixed objects in the field of fire of the battery.

CASEMATE ELECTRICIAN

I. Definitions C. A. D. R.

II. Casemate apparatus.
(a) Nomenclature.
(b) Testing.
(c) Circuits.
(d) Maintenance.

III. Troubles and remedies.
(a) Lamps and bells.
(b) Switches.
(c) Ammeters and voltmeters.
(d) Telephones.
(e) Engines and machines.

CHIEF PLANTER

I. Definitions C. A. D. R.

II. Mine planting material.
(a) Voltmeter test of a mine circuit.
(b) Hydraulic jacks.
(c) Nomenclature and use of apparatus aboard mine planters used in planting mines.
(d) Capacity of falls and winches.
(e) Automatic anchor.

III. Drill.
  (*a*) Duties of noncommissioned officer on distribution box boat.
  (*b*) Duties of noncommissioned officer in charge of planting mines from mine planter.
  (*c*) Boat drill with yawl boat.
IV. Emergencies.
V. Cordage.

CHIEF LOADER

I. Definitions C. A. D. R.
II. Explosives.
  (*a*) Storage of explosives.
  (*b*) Gun-cotton.
  (*c*) Drying gun-cotton and gun-cotton primers.
  (*d*) Preparation of gun-cotton primers from square cakes.
  (*e*) Dynamite.
  (*f*) Nitroglycerin.
  (*g*) Evidence of free nitroglycerin in dynamite.
  (*h*) Method of decomposing nitroglycerin to render it harmless.
  (*i*) Preparation of priming charges.
  (*j*) Trotol.
III. Fuses.
  (*a*) Description.
  (*b*) Tests.
  (*c*) Storage of fuses.
  (*d*) Preparation of fuses for loading plugs.
IV. Loading-room duties.
  (*a*) Testing transformer and measuring the resistance of its circuits.
  (*b*) Assembling and testing a compound plug.
  (*c*) Loading a mine and preparing it for delivery to planter.
V. Unloading mines.
  (*a*) Precautions.
  (*b*) Returning charge to storage boxes.
  (*c*) Determination of amount of water to add to gun-cotton.

COXSWAIN

The scope of the examination for coxfwain will be the same as that prescribed for chief planter, except III (*b*), for which the following is substituted: Theoretical operation of a distribution box boat, involving a knowledge of the navigation "Rules of the Road," as published in Artillery Bulletin No. 117 (Serial No. 132)—(See Appendix "D").

DEFINITIONS

(Numbers refer to paragraphs in the 1914 Drill Regulations.)

577. *Aiming.*—[Pointing the gun by means of a sight.] (See Pointing.)

589. *Axis of cannon or axis of bore.*—The central line of the bore.

591. *Azimuth (of a point).*—In coast artillery usage, the horizontal angle measured in a clockwise direction from the south line through the observer's position to the line from the observer to the point. For example, the azimuth of a point B from A is the angle (measured clockwise from the south) between the north and south line through A and the line from A to B. The north point has an azimuth of 180°.

594. *Base line.*—A horizontal line the length and direction of which have been determined. This line is used in position finding, especially for long ranges; the stations at its ends are called "observing stations." It is called "right-handed" or "left-handed," depending on whether the secondary station is to the right or left of the primary from the point of view of a person facing the field of fire. The base end observing stations are called primary, secondary, or supplementary.

596. *Battery.*—One or more guns or mortars grouped with the object of concentrating their fire on a single target and of being commanded directly by a single individual, together with the entire structure erected for their emplacement, protection, and service.

602. *Breech.*—The mass of metal behind the plane of the rear section of of the bore of a cannon, the section being taken at right angles to the axis of the bore.

603. *Breechblock.*—The metal plug which closes the breech of a cannon.

606. *Breech mechanism.*—The breechblock, obturating device, firing mechanism, and all parts used in operating the breechblock of a cannon.

607. *Breech recess.*—The opening in a cannon which receives the breechblock.

608. *Breech reinforce.*—The part of a cannon in front of the breech and in rear of the trunnion band.

609. *Caliber.*—The diameter of the bore in inches, measured between diametrically opposite lands. It is the minimum diameter of the rifled portion of the cannon.

610. *Cannon.*—Artillery weapons from which projectiles are thrown by the force of expanding powder gases. (See "Gun or piece.")

Cannon are of three classes: Guns, mortars and howitzers.

Guns are long (generally 30-35 calibers), have flat trajectories, and are used for direct fire (not exceeding 20°), with high velocities.

Mortars are short (about 10 calibers), and are used for high-angle fire (above 45°), with low velocities.

Howitzers are short guns and are used for curved fire (not exceeding 45°), with low velocities.

Cannon of the United States land service are classified according to their use into coast, siege, field, and mountain.

Built-up cannon are made by shrinking forgings (jacket and hoops) over an inner tube. Wire-wound cannon are made by winding wire under tension around a tube; a jacket and hoops may be shrunk over the wire-wound tube.

614. *Carriage or mount.*—The means provided for supporting a cannon. It includes the parts for giving elevation and direction, for taking up the recoil on discharge, and for returning the piece to the firing position.

615. *Carriage, fixed.*—A mount provided for guns and mortars in permanent works and not designed to be moved from place to place.

616. *Carriage, movable (wheeled mount).*—A carriage or mount provided with wheels for transportation of the piece mounted thereon.

617. *Carriages, seacoast.*—Those used for coast artillery cannon. They may be divided into four classes, depending upon the nature of cover afforded by the emplacements.

(*a*) *Barbette:* Where the gun remains above the parapet for loading and firing. Barbette carriages are used for guns of 3-inch or greater caliber. The pedestal mount is a type of barbette carriage used for guns up to six inches in caliber.

(*b*) *Disappearing:* Where the gun is raised above the parapet for firing, and recoils under cover for loading. This mount is used for guns of 6-inch or greater caliber.

(*c*) *Masking parapet mount:* Where the gun remains above the parapet for loading and firing but can be lowered below the level of the crest for concealment. This mount is also called the balanced pillar mount and is used for guns up to five inches in caliber.

(*d*) *Casemate:* Where the gun fires through a port.

626. *Charge.*—The explosive placed in a gun or mortar behind the projectile as a propellant (propelling charge). Also the explosive placed in the cavity of a projectile (bursting charge).

627. *Charge (or powder) section.*—One of the component parts of a charge when the charge is made up of two or more separate parts.

628. *Chase.*—That part of a cannon in front of the trunnion band.

631. *Clinometer.*—An instrument for measuring vertical angles with great accuracy; for example, the inclination of the axis of the bore to the horizontal.

633. *Coast artillery militia.*—Troops of the organized militia organized as coast artillery for the purpose of supplementing the regular coast artillery in time of war.

634. *Coast artillery supports.*—Troops of the mobile army assigned to coast artillery forts to repel land or landing attacks in the immediate vicinity of the fortifications.

651. *Drift.*—The divergence of the projectile from the plane of departure due to the rotation of the projectile, and the resistance of the air. It is affected by the ballistic character of the projectile. It is in the direction of rotation and for the United States service rifled guns it is to the right. It may be expressed either in yards or degrees.

654. *Elevation.*—The inclination in a vertical plane given to the axis of the bore in pointing a gun; the angular elevation of the axis of the bore above the line of sight is the sight elevation; the angular elevation of the axis of the bore above the horizontal is the quadrant elevation.

656. *Emplacement.*—That part of the battery pertaining to the position, protection, and service of one gun, mortar, or group of mortars.

657. *Emplacement book.*—A book containing all necessary data concerning the battery.

668. *Field of fire.*—The area covered by the armament of a battery, or with reference to a single gun, it is the area covered by that gun.

684. *Gun or piece.*—A general term applied to any firearm from which a missile is propelled by the force of expanding gas. In a restricted sense, the term "gun" is applied as defined under "Cannon."

687. *Gun platform.*—That part of the battery upon which the gun carriage rests.

691. *Hoop.*—A forging superposed upon the jacket, tube, or other hoops of a cannon.

697. *Jacket.*—The principal forging shrunk on the breech end of a tube of a cannon.

704. *Line of sight.*—The axis of collimation of the telescope or the straight line passing through the sights of the piece; at the instant of firing this line passes through the center of the target.

706. *Loading platform.*—That surface upon which the cannoneers stand while loading the piece.

709. *Machine guns.*—Guns of one or more barrels using fixed ammunition and provided with mechanism for continuous loading and firing. The mechanism may be operated by man power or by the force of recoil.

Guns in which the force of recoil is used to operate the breechblock are termed "semi-automatic." When this force is used also to load and fire the guns, they are termed "automatic."

710. *Magazine.*—A room for storage of powder, primers, or fuses, etc.

715. *Muzzle.*—The front end of a cannon. The face of the muzzle is the front plane of the gun perpendicular to the axis of the bore.

716. *Muzzle or initial velocity.*—The rate of travel in feet per second at which a projectile leaves the muzzle of a gun.

720. *Parapet.*—That part of a battery which gives protection to the armament and personnel from front fire.

725. *Pit.*—That part of a mortar emplacement designated for mounting one or more mortars, usually two or four.

733. *Pointing.*—The operation of giving the direction and elevation necessary to hit the target. When the sight is used it it called "aiming"; when the sight is not used, it is called "laying."

There are three cases of pointing:

Case I. When direction and elevation are both given by the sight.

Case II. When direction is given by the sight, and elevation by the range scale on the carriage or by quadrant.

Case III. When direction is given by the azimuth scale and elevation by quadrant or by the range scale on the carriage.

734. *Position finder.—An instrument for locating a target.*

736. *Powder chamber.*—The portion of the bore for the reception of the powder charge. It is between the breech recess and the centering slope.

740. *Primer.*— The device used for igniting the propelling charge. Primers may be friction, percussion, electric, or combination (electric and friction).

745. *Range.*—In a limited sense, the horizontal distance from the gun to the target. In a general sense, it is applied to horizontal distances between position finder and target, position finder and splash, gun and splash, etc. The range of a shot is the horizontal distance from the muzzle of the gun in the firing position to the point of splash. (Practically, the range is

reckoned from the axis of the gun trunnions in the firing position, instead of from the muzzle ,but the difference in range is negligible.) * * * * *

749. *Rapid-fire gun.*—A single-barrel breech-loading gun provided with breech mechanism, mounting, and facilities for loading, aiming, and firing with great rapidity. The breech mechanism is operated by a single motion of the handle or lever. The smaller calibers use fixed ammunition.

753. *Recoil.*—The backward movement of the gun on firing. Counter recoil is the return of the gun in battery.

754. *Recoil cylinders.*—Hydraulic cylinders for controlling the recoil.

758. *Rifling.*—Helical grooves cut in the surface of the bore for the purpose of giving a rotary motion to the projectile. The rib of metal between two adjacent grooves is called a "land." (See Twist of rifling.)

775. *Sight.*—A device by which the gun pointer gives the gun the proper direction for firing. Sights are of two classes, open and telescopic.

787. *Time interval bell or T-I bell.*—A bell to indicate the observing interval. Bells ring simultaneously at the emplacements and the observing stations. They are operated by a clock or a motor.

798. *Trunnions.*—The cylinders which rest in bearing surfaces of the carriage called "trunnion beds." Their axis is perpendicular to the axis of the bore and ordinarily in the same plane; they connect the cannon with the carriage and transmit the force of recoil from one to the other. The faces of the trunnions are the end planes perpendicular to their axis.

800. *Tube.*—The inner cylinder of a cannon.

801. *Twist of rifling.*—The inclination of the grooves to the axis of the gun at any point. When this inclination is constant the twist is uniform; when it increases from the breech to a point near the muzzle it is increasing. Twist is generally expressed in turns per caliber, *e.g.*, one turn in 50 calibers, meaning that the projectile makes one complete rotation in passing over a distance equal to 50 calibers, provided the twist were uniform. In most of the major caliber guns in our service, the twist increases from one turn in 50 calibers to one turn in 25 calibers at a short distance from the muzzle, and beyond that point it is uniform.

803. *Vent.*—A small channel leading from the exterior of the cannon to the powder chamber for the ignition of the powder charge. It is an "axial vent" when it is in line with the axis of the bore. It is a "radial vent" when it is at right angles to the axis of the bore.

APPENDIX "C"

MANNING STATION AND BATTERY

(Numbers refer to paragraphs in the 1914 Drill Regulations)

ORGANIZATION

24. A mine company will be divided into sections as follows: One planting and loading section, one range and power section, and for each emplacement manned, one gun section. Members of the planting and loading section may also be assigned to gun sections, since in general the service of the latter will not take place simultaneously with that of the former. Sections will be sub-divided into detachments and details for manning the matériel to which assigned.

25. The senior noncommissioned officer of each section, detachment, or detail is its chief. Each chief will command his subdivision and will be responsible for its drill, its efficiency, and the condition of the matériel to which it is assigned.

MARCHING MANEUVERS

The company is formed and marched off according to drill regulations. (Paragraphs 37 to 39.)

TO POST THE SECTIONS

40. The company commander marches his company to its battery or station, and as he approaches the battery or station commands *SECTIONS POSTS.* At the second command, each chief of section falls out of ranks, marches his section to a point near its emplacement or station, and commands *DETAILS POSTS.* At the second command all details fall out, procure equipments and implements, and take their posts.

Each chief of section determines whether all apparatus and material to be served by his section is in order, and reports to the officer directly over him, "Sir, ——— in order," or reports defects he is unable to remedy without delay. As soon as the chiefs of section have reported, the officers report to the battery commander, who then reports to the fire commander "——— in order (inserting name of battery)," or reports defects he is unable to remedy without delay. (The reports from mine companies are made to the mine commander.)

If he so desire, a company commander may post the sections separately, at any point of the march, by commanding: ——— *SECTION, POST.* The section designated is posted as described above.

When a range section leaves the column, the range officer falls out and proceeds direct to his station.

Details for remote stations may be marched to their stations from the company parade by their respective chiefs.

TO DISMISS THE SECTIONS

41. Battery commanders command *DISMISSED.* Range officers command *CLOSE STATION* (or *CLOSE STATIONS*). Emplacement officers

command *REPLACE EQUIPMENTS.* Chiefs of sections command *FORM SECTION.* The company is formed on the battery parade and is marched by the battery commander to the company parade and dismissed.

Subdivisions from remote stations are marched to the company parade and dismissed by their chiefs.

GUN COMMANDER

69. Each emplacement of a gun battery is commanded by a gun commander * * * * who is responsible to the emplacement officer for the condition of the matériel and the efficiency of the personnel of his section. The gun * * * commander will supervise the gun cleaning and will require the mechanic to keep pieces and carriages in excellent condition. He will supervise the service of the piece.

70. The gun * * * commander will have charge of the entire emplacement under the emplacement officer, and during the absence of the emplacement officer, he will perform the duties prescribed for the emplacement officer. After the details have been posted as prescribed in paragraph 40, he will command *EXAMINE GUN.* He will make a general inspection of the gun and carriage, paying especial attention to the recoil cylinders, the firing device, and the oiling of the various bearings. He will report to the emplacement officer, "Sir, No. ——— in order," or will report defects he is unable to remedy without delay.

71. At the conclusion of the exercises for the day, he will command *FORM SECTION* after the emplacement officer has commanded *REPLACE EQUIPMENTS* (par 41). He will supervise the replacing of equipments and implements, will see that the piece is secured, and will then form his section on the battery parade.

METHODS OF POINTING

223. *Case I.*—This method of pointing is used only with rapid-fire guns where means for laying in elevation by quadrant have not been provided. Direction and elevation are given by the sight.

The gun pointer adjusts the sight in its seat and sets the elevation and deflection scales for the indicated range and deflection, respectively.

Case II.—This is the normal method of pointing all guns. Direction is given by the sight and elevation by an elevation or range scale attached to the carriage. * * * The gun pointer sets his sight to the deflection shown on the deflection recorder's board.

* * * * * *

RANGING

(a) TO RANGE FROM ONE GUN

98. The Battery Commander commandes *NO.* —— *FIRE ONE SHOT;* the piece is loaded and fired, under the direction of the gun commander, at the corrected range and deflection indicated on the transmission device. With the vertical wire of his sight set at the deflection used by the ranging gun, each gun pointer follows the target by traversing the gun until the instant of splash, when he stops traversing, quickly moves the vertical wire to the splash without moving the gun, then reads and reports his deflection to the battery commander.

(b) SHEAF RANGING

99. Sheaf ranging consists in firing two or more guns at the same instant with their range settings differing by equal increments, and increased or decreased from the right by the specified increment in yards, observing the relative positions of target and splashes, and making corrections from these observations.

100. The battery commander designates the ranging gun and the range difference between adjacent guns and commands *SHEAF RANGING,* at which command all guns are loaded. The ranging gun is laid on the range shown on the mechanical transmission device. Other guns are laid on this range corrected for their proper range differences. All guns are fired on a signal from the battery commander. All gun pointers determine and report their deflections as prescribed for ranging from one gun. Spotters report the distance of the nearest splash from the target in terms of multiples of the sheaf, Second (or other) Splash Short ——— (or Over), as 'Third Splash Short ¼. * * * * *

PRECAUTIONS FOR SAFETY

242. In case of a misfire in artillery practice the primer will not be removed and a new one inserted for at least ten minutes; during the interval, the piece will be laid on some portion of the field of fire where its discharge will not endanger shipping.

243. If firing by electricity, the circuit will be broken before the primer is removed. When using fixed ammunition and percussion primers, a second trial of the primer will be made if the firing device can be cocked by hand without opening the breech, but if this also fails, the breech will not be opened and a new cartridge substituted within ten minutes. * * * *

238. When service ammunition is fired from guns (or mortars) above 4.7" in caliber, or when blank ammunition is fired from guns (or mortars) of any caliber, the powder chambers will be sponged and the mushroom head wiped off after each round and before loading for the next round, in order to insure the extinguishment of all sparks and the removal of smouldering fragments. The sponge and cloth used for this purpose will be dipped in hydrolene oil and the surplus oil will be removed from them before they are used.

247. In firing salutes, the powder chamber of the gun will be sponged and the mushroom head wiped off after each round to extinguish all sparks and to remove residue. The sponge and cloth used for this purpose will be dipped in hydrolene oil and the surplus oil will be removed before using. Worn sponges or those that do not fill the chamber of the gun will not be used.

244. At the command *CEASE FIRING,* * * * with rapid-fire guns using the metallic cartridge cases, the breech will be opened. * *

239. Immediately after firing, the piece and accessories will be inspected by the battery commander and a report on their condition will be made by him (through the fire and fort commanders) to the coast defense commanders. The bores of pieces will be washed clean with water, dried, and oiled. The breechblocks will be dismantled, and all parts cleaned and oiled.

INSPECTION

335. The armament will be manned, instruments will be adjusted, and everything will be prepared for service.

337. As the inspector approaches any station, the officer or noncommissioned officer in charge will call his command to attention, and will salute.

The equipment will be inspected and operated as may be necessary to determine its working condition and the efficiency of the personnel

338. As the inspector approaches a battery, he will be met and saluted by the battery commander, who will accompany him during the inspection of the battery.

339. When the inspector approaches a gun emplacement, the gun commander will command *ATTENTION, OPEN BREECH,* and will give such other commands as may be necessary for the execution of the inspector's instructions.

341. An artillery inspection will be conducted so as to include the following:

(*a*) An examination of the equipments, the implements and all the parts of the guns, carriages, and emplacements, special attention being given to:

Obturators, to see if they are adjusted properly and pads in serviceable condition.
Elevating and traversing mechanisms.
Devices for running in and from battery.
Recoil cylinders.
Throttling valves.
Oil holes and grease cups.
Adjustment of sights and means of giving quadrant elevation.
Adjustment of subscales of azimuth circles.
Firing attachments.
Firing batteries and circuits.
Motors and controllers.
Sponges.
Rammers.
Condition of doors.
Condition of drains and diagrams of same posted.
Condition of hoists.
Condition of electric and other lights.
Condition of electric installation and power plants.
Condition of galleries and magazines.
Condition of emplacements and grounds in their vicinity.

(NOTE.—All doors should be opened and closed. In preparing guns, mortars, and their carriages for inspection, a thin coating of lubricant will be left on bearing surfaces.)

(*b*) Examination of fire-control stations and apparatus, special attention being given to the condition and adjustment of all instruments and appliances, tables, and charts, and to the knowledge observers and operators have of adjustments and operation of instruments, appliances, tables, and charts.

* * * * * * *

(*d*) Examination of mining casemate, storeroom, loading room, wharves, boat-houses, cable tanks, and mine-planting boats, special attention being given to:

Operating boards.
Engines.
Motors and generators.
Storage batteries.
Sleeping rooms.
General condition of buildings.
Painting of the mine cases.

Piling of the mine cases.
Lubrication of screw threads on all apparatus.
Condition of anchors, distribution boxes, mooring ropes, and raising ropes.
Condition of small tools and supplies.
Condition of cranes, tram cars, and trucks.
Storage of the cable and security of all ends above the water.
Examination of cable-testing records.

And for boats:

General condition.
Condition of engines.
Condition of hoisting apparatus.
Condition of davits and blocks.
Condition of cable-laying apparatus.
Condition of small tools.
Condition of men's quarters.
Knowledge and expertness of personnel.

(*e*) An examination of the uniform of the personnel.

(*f*) An examination of emplacement and fort record books.

APPENDIX "D"

MANUAL FOR SMALL BOATS

Definitions

The left hand side of a boat or ship, looking toward the bow, is the *port* side, and the other is the *starboard* side. The men who row on the port side are called the port oars and those rowing on the starboard side are called the starboard oars.

Boats are called *single-* or *double-banked*, according as they have one or two oarsmen to a thwart.

Thwarts are the seats on which the crew sits; the space abaft the after thwart is called the *sternsheet*.

Floorings and *gratings* are the bottom boards of a boat. They prevent the weight from bearing directly upon the planking.

The *gunwale* of a boat is the upper rail.

The *yoke* is an athwartship piece of wood or metal fitting over the rudder-head.

Yoke-lanyards are the small lines made fast to the ends of the yoke, by which the rudder is turned and the boat steered.

The *stem* is the upturned portion of the keel at the bow of the boat, to which the forward ends of the planks are secured.

Oars are said to be *double-banked* when two men pull one oar. The *blade* of an oar is the broad flattened part. The *handle* is the small part of an oar on the inboard end of the loom, which the oarsman grasps when pulling. The *loom* is the portion of an oar extending from the blade to the handle. The *leather* is the portion of an oar which rests on the rowlock. This is sometimes covered with canvas, but is usually covered with leather—hence the name.

Feathering is the term applied to the operation of turning the blades nearly flat to the water after the stroke, with the upper edge turned forward, especially valuable in rowing against a head-wind.

Rowlocks are forked pieces of metal in which the leather of the oars rests while pulling. Swivel rowlocks are movable, a pin on the rowlock fitting into a socket in the gunwale.

Thole pins are wooden pins set vertically in the gunwale and are used in place of rowlocks.

The *sterring rowlock* is a peculiar form of swivel rowlock (fitted near the stern of the boat) in which the steering oar is shipped. This is sometimes called a crutch.

The *painter* is a rope secured in the bow for towing or securing the boat.

Boat-falls are tackles made with two blocks and a length of rope; used for hoisting boats.

The *plug* is the wooden stopper fitted into a hole in the bottom of a boat to let water in or out.

A *boat-breaker* is a small keg used for carrying fresh water.

A *boat-recall* is an understood signal made to order a boat's return.

Boat Orders

Oars and rowlocks having been placed in the boat, blades of oars toward the bow; rudder and yoke (if any) stepped and the yoke lanyards clear; the men board and take their proper seats. The man pulling the bow oar is No.1, the next man is No. 2, and so on to the man pulling the stern-oar who is called the "stroke-oar." The men being seated, with oars handy, the bow man, who may be No. 1 or an extra man, as convenient, holds onto the wharf, side, or piling, as the case may be, with his boat hook.

Shove off.—At this command the bow-man shoves the boat clear, giving her headway if possible. He boats his boat hook and takes his seat.

Up oars.—The crew simultaneously seize and raise their oars smartly to the vertical (guiding on the stroke-oar) and hold them directly in front of them, the blades fore and aft, inboard hands grasping the handles, holding the same well down between the knees, outboard hands grasping the looms at the height of the chin.

Let fall.—The oars are eased down into the rowlocks together, brought level with the gunwale, blades horizontal and all trimmed on the after oars. Oars must not be allowed to splash under any consideration.

(1) *Give way together,* (2) *GIVE WAY.*

At the first command the men reach well forward, blades nearly vertical, ready for the stroke. At the second command they dip their oars at the same time as the stroke-oar and commence rowing, keeping stroke exactly and all lifting their blades to the height of the gunwale on the return. (Or higher if waves render this necessary.)

To Make a Landing

In running alongside a vessel or up to a float-stage or wharf, when several lengths away from same, give the command (while the oars are in the water), *IN BOWS.* The bow oarsman (if there be no extra man in the bow) finishes his stroke, then "tosses" and boats his oar, blade to the bow, and stands ready with the boat hook to fend off and hold the landing. When there is sufficient headway to carry the boat properly to the landing, give the command, *WAY ENOUGH.* This order is given while the oars are in the water; the men finish the stroke, then toss and boat their oars with as little noise as possible. The oars are next the rail, the after oars outboard of the bow oars. If the stroke oarsman is provided with a boat hook, he grasps it and stands ready to help the bow man.

If it be desired to stop rowing temporarily, give the preparatory command, (1) *Stand by to lay on oars,* at which the crew pay strict attention. Then, when ready, give (2) *OARS.* At this command, given while the oars are in the water, the crew finish the stroke and bring the oars level with the gunwale, blades horizontal, trimmed on the after oars. This position is also used for salutes, as noted hereafter.

If you are going to pass so close to another boat that a collision of oars, seems probable, command (1) *Trail,* (2) *OARS.* At the second command, given while the oars are in the water, the men finish the stroke, and then, while the oars are still in the water, by lifting the handles with their outboard hands, the looms are thrown out of the rowlocks. The men carry their hands outboard till the backs of their wrists rest on the rails and the oars trail astern. (This movement is used in shooting bridges, where lack of head room precludes tossing.)

To bring the oars inboard, command: *OARS.*

At this command the men raise the handles, lower the looms into the rowlocks, and then raise the blades out of the water and swing the oars to the regular position of *let fall.*

In order to turn the boat short around (being stationary or nearly so) command: (1) *Give way, starboard; back port,* (2) *GIVE WAY;* or (1) *Give way, port; back, starboard,* (2) *GIVE WAY.* The crew keeps stroke just as regularly as in pulling straight away. As soon as the boat points in the desired direction command: (1) *Give way together,* (2) *GIVE WAY.*

If it is desired to check the boat's headway, command: *HOLD WATER.* At this command the men drop their blades vertically into the water, tops of blades inclined slightly forward, inboard hands grasping the handles, outboard arms over the looms to steady the oars against the chest. To prepare the crew for rowing, command *OARS,* at which they resume the position described under the heading *let fall.*

To move the boat astern command *STERN ALL.*

At this command the men back water, keeping stroke as regularly as in ordinary rowing. To resume the position of attention give the command *OARS,* as before.

To toss oars command: (1) *Stand by to toss,* (2) *TOSS.*

The command of execution is given while the oars are in the water, the stroke is completed and the oars raised smartly to the vertical, with blades fore and aft, handles of oars on bottom boards, the wrists of the inboard hands resting on the thighs, outboard hands grasping the looms at the height of the chin, crew sitting upright. To place the oars in the boat give the command *BOAT YOUR OARS.* At this command the oars are lowered toward the bow (not swung outboard) and laid in the boat as before described. This command may be given from the position of *let fall,* in which case the men toss their oars and proceed as above.

Notes

In rowing, the blade of the oar should be raised as high as the gunwale after leaving the water and feathered by dropping the wrist. A barely perceptible pause should be made, and the oar next thrown well forward and dropped edgewise into the water, taking care to avoid splashing and chopping. Now swing the oar smartly through the water without giving it any final jerk, and repeat as above. With green crews it may be found necessary for the coxswain to call *stroke, stroke,* in order to get the men to pull exactly together.

There should be a mark on the loom of the oar (about the height of the eyes when the oar is *at toss*) to show when the blade is fore-and-aft, thus avoiding the necessity of the men gazing up for the purpose of finding out when this is the case.

Never allow a boat's crew to splash with the blades when executing *let fall.*

When resting on oars, insist that they be kept level with the gunwale and at right angles to the keel.

Talking among the crew and turning the heads to look at any object should never be allowed while the boat is under way.

In most cases, boats should be permanently equipped with a small breaker of fresh water, a spare oar and rowlock, and a suitable anchor or grapnel. The anchor rope to withstand a storm should be six (6) times as long as the greatest depth liable to be used as an anchorage. For any small

boat in our service a 20-pound anchor and 12-thread (about 1-inch) manila hawser should easily weather a hurricane.

A boat should never go out at night without a good, well filled lantern. Many a boat has been run down through its inability to make its presence known.

Before leaving the shore in foggy weather, provide the boat with some sort of a foghorn and a compass, and calculate as nearly as possible the bearings of the landing you wish to make. Take the opposite of this upon returning, making due allowance for tide and wind in both cases.

To ride out a gale of wind in an open boat, lash the oars and grating together, making them into a bulky bundle and weight them if possible; span them with the painter and pitch them overboard. This will keep the boat's head to the sea and prevent her from drifting fast. Assist the boat to take the seas head-on by means of a steering oar.

In rowing through a chop, where the rudder is apt to be pitched clear of the water, it should be unshipped and a steering oar used instead.

Remember, in making a landing, that the heavier the boat is laden the longer she will keep her way.

If you are being towed by a steamer, make her give you a line, instead of using your own, and belay it so it can be cast off in a hurry. Carefully avoid weighing down the bow; always use a short tow line when the boat is empty and a long one when the boat is laden. If the boat's painter is used for a towline, have a knife ready for cutting it if it becomes necessary. Never go close under a steamer's stern unless it is absolutely unavoidable.

Officers in boarding a ship, use the starboard gangway, although they may use the port gangway. Enlisted men use the port gangway or the booms unless otherwise ordered.

Rules of the Road and Buoyage System in the United States Waters*

RULES OF THE ROAD

NOTE.—The following is a summary of the "Rules for Preventing Collisions at Sea and Upon Inland Waters of the United States" which apply to boats.

Lights

The rules concerning lights shall be complied with in all weathers from sunset to sunrise.

1. All power boats under 26 feet in length shall carry aft a white light to show all around the horizon, and forward, lower than the white light aft, a combined lantern showing red to port and green to starboard, so fixed as to throw the light from right ahead to 2 points abaft the beam on each side.

2. All power boats designed to be carried on board ship, and 26 feet or more in length, shall carry (a) a bright white light as near the stem as practicable showing 10 points on each side of the vessel; that is, from ahead to 2 points abaft each beam; (b) a white light aft to show all around the horizon; (c) a screened green side light on the starboard side and a screened red side light on the port side, constructed and fixed as prescribed for steam vessels.

3. Rowing boats, whether under oars or sail, shall have ready at hand a lantern showing a white light, which shall be temporarily exhibited in time to prevent collision.

* Rules of the Road and Buoyage System in the United States Waters—ARTILLERY BULLETIN No. 117 (Serial No. 132).

4. For an anchor light an ordinary hand lantern showing a white light is to be exhibited when required.

Sound Signals for a Fog

1. All power boats designed to be carried on board ship are provided with a whistle or other sound-producing appliance capable of producing a blast of 2 seconds' or more duration.

2. All power boats designed to be carried on board ship, and 26 feet or more in length, shall carry an efficient foghorn and an efficient bell.

3. In fog, mist, falling snow, or heavy rainstorms, whether by day or night, a power boat shall make the following signals at intervals of not more than one minute:

(a) If under way and not towing or being towed, a prolonged blast of two or more seconds on the whistle or foghorn.

(b) If under way and towing, three blasts in succession on the whistle or foghorn, namely, one prolonged blast followed by two short blasts.

(c) If at anchor, ringing of the bell for about five seconds.

4. A power boat is under way within the meaning of these rules when she is not anchored or made fast to the shore or a ship, or aground.

Speed in a Fog

Boats shall, in a fog, mist, falling snow, or heavy rainstorms, go at a moderate speed.

Steering and Sailing Rules

1. When two boats under sail are approaching one another so as to involve risk of collision, one of them shall keep out of the way of the other, as follows:

(a) A boat which is running free shall keep out of the way of a boat which is close-hauled.

(b) A boat which is close-hauled on the port tack shall keep out of the way of a boat which is close-hauled on the starboard tack.

(c) When both are running free, with the wind on different sides, the boat which has the wind on the port side shall keep out of the way of the other.

(d) When both are running free, with the wind on the same side, the boat which is to windward shall keep out of the way of the boat which is to leeward.

(e) A boat which has the wind aft shall keep out of the way of other boats.

2. When two boats under power or oars are meeting end on, or nearly end on, so as to involve risk of collision, each shall alter her course to starboard so that each may pass on the port side of the other.

3. When two boats under power or oars are crossing so as to involve risk of collision, the boat which has the other on her own starboard side shall keep out of the way of the other.

4. When a boat under power or oars and a boat under sail are proceeding in such directions as to involve risk of collision, the boat under power or oars shall keep out of the way of the boat under sail.

5. Where by any of these rules one of the two boats is to keep out of the way, the other shall keep her course and speed.

6. Every boat which is directed by these rules to keep out of the way of another boat shall, if the circumstances of the case admit, avoid passing ahead of the other.

7. Every boat under power which is directed by these rules to keep out of the way of another boat shall, on approaching her, if necessary, slacken her speed or stop or reverse.

8. Every boat, whether under power, oars, or sail, when overtaking any other shall keep out of the way of the overtaken boat.

9. Any boat under power approaching another which is in sight of her shall indicate what course she intends to take by the following signals on her whistle:

(*a*) One short blast to mean "I am directing my course to starboard."

(b) Two short blasts to mean "I am directing my course to port."

(c) Three short blasts to mean "My engines are going at full speed astern."

(d) The words "short blast" to mean a blast of about one second's duration.

10. In a narrow channel every boat under power or oars shall, when it is safe and practicable, keep to that side of the fairway or mid-channel which lies on the starboard side of such boat.

11. Whenever a boat under power is nearing a short bend or curve in a river or harbor she should give a long blast on the steam whistle.

12. Boats under power when leaving a ship to proceed ahead and cross to the other bow should give the proper signal on whistles.

13. Due regard shall be had to all dangers of navigation and collision, and to any special circumstances which may render a departure from the above rules necessary in order to avoid immediate danger.

BUOYS

1. In coming from seaward, red buoys mark the starboard or right-hand side of the channel, and black buoys the port or left side.

2. Dangers and obstructions which may be passed on either side are marked by buoys with black and red horizontal stripes and may be left on either hand.

3. Buoys indicating the fairway are marked with black and white vertical stripes and should be passed close to.

4. Sunken wrecks are marked by the red and black obstruction buoys described in paragraph 2. In foreign countries green buoys are frequently used to mark sunken wrecks.

5. Quarantine buoys are yellow.

6. As white buoys have no special significance they are frequently used for special purposes not connected with navigation.

7. The starboard and port buoys are numbered from the seaward end of the channel, the black bearing the odd and the red the even numbers.

8. Perches with balls, cages, etc., will, when placed on buoys, be at turning points, the color and number indicating on which side they shall be passed.

COURTESIES

The following courtesies should govern boats meeting or passing each other:

(1) No junior should pass ahead of a senior without permission.

(2) Salutes should be exchanged whenever boats pass near enough to each other for the senior officer to be recognized, whether he be in uniform or not.

(3) The junior should always salute first, and the senior should return the salute by touching his cap.

(4) Officers without a flag or pennant flying should be saluted with the

hand only; those with a flag or pennant flying should, in addition, be saluted by laying on oars.

(5) When a non-commissioned officer is in a boat and meets another boat containing an officer, he stands and salutes. If the boat flies a flag or pennant, the non-commissioned officer, in addition, lays on oars.

(6) Officers of the Navy and Marine Corps and foreign officers in boats should always be saluted when recognized.

(7) In laden boats, towing boats, or boats under sail, the hand salute only, is made on all occasions.

(8) Coxswains in charge of boats shall always rise and salute when officers enter or leave their boats.

(9) Boat keepers shall stand up and salute officers passing in boats and remain standing until the boat has come alongside or passed.

APPENDIX "E"

DUTIES OF PLANTER DETAILS

This statement of duties of planter details was prepared by Captain A. C. Hasbrouck, C. A. C., for use in connection with the instruction of mine companies during the visits of the Mine Planter *General John M. Schofield*. A copy has been furnished each mine company by authority of Chief of Coast Artillery.

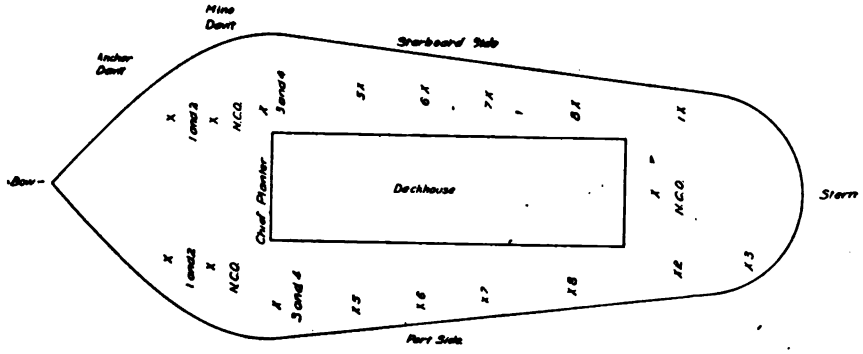
The Planter Detachment consists of three non-commissioned officers and twenty privates, assigned as follows:

Chief Planter:	1 N.C.O.
Starboard Detail:	1 N.C.O. 8 privates.
Port Detail:	1 N.C.O. 8 privates.
After Deck Detail:	1 N.C.O. 3 privates.
Recorder:	1 private (or musician).

DUTIES OF PLANTER DETAILS IN PLANTING MINES

Chief Planter:	In general charge, on deck. Reports to officer in charge when each mine is ready for planting.
Starboard Detail:	(Port Detail similar in every respect.) Non-commissioned officer in general charge. Reports to chief planter when each mine on his side is ready for planting.
Anchor Davit Men, Nos. 1 and 2:	Prepare and handle anchor. No. 1 handles tripping lanyard. No. 2 lowers anchor.
Mine Davit Men, Nos. 3 and 4:	Prepare and handle mine. No. 3 handles tripping lanyard. No. 4 lowers mine, and, when automatic anchor is used, handles distance weight.
Heaving Line Man, No. 5:	Throws heaving line to D. B. boat and handles buoy. He backs up No. 5 on port side, and assists in passing cable.
Cable Men, Nos. 6, 7, and 8:	Pass Turk's-head end of cable to D. B. boat, keeping slight strain as cable pays out. Handle cable, casting it clear of the side. Both starboard and port numbers may be required to work both sides.
After Deck Detail:	Non-commissioned officer in general charge. Calls to upper deck "All Gone" when only one coil of cable remains to pay out. Nos. 1, 2, and 3 pay out cable clear. No. 1 always keeps one coil ahead lifted clear and ready to pay out.

Recorder: Posted on upper deck aft, calls through megaphone to officer in charge "All Gone" when he receives word from main deck, and "All Clear" when the planter has cleared the mine buoy. He keeps records of times, milli-ammeter readings, and submergences.



POSTS OF PLANTER DETAILS

DUTIES OF PLANTER DETAILS IN RAISING MINES

(Note:—The duties as given are for raising a mine on the starboard side. In raising one on the port side, the port detail performs the duties prescribed here for the starboard detail, and the starboard detail those for the port.)

Chief Planter: In general charge, on deck.

Port Detail: N.C.O. superintends clearing his own side and then assists starboard N.C.O.

No. 1 has boat hook ready to catch heaving line as it is passed from D.B. boat. He operates steam winch.

Nos. 1-2 coil raising rope.

No. 2 handles raising rope to and over gypsy head of winch.

No. 3 helps on cable and then operates electric winch.

No. 4 helps on cable then handles fall of raising whip around drum of electric winch.

No. 5 tends snatch-block near cathead. Passes cable over davit anchor after raising rope is clear. Assists on cable.

Nos. 6-7 assist N.C.O. in clearing port side. Then change to starboard side and assist in hauling cable aft, taking posts about 10 feet aft of their corresponding numbers.

No. 8 coils up loose end of heaving line, as he walks aft. Then assists No. 8 starboard hauling cable.

Starboard Detail: N.C.O. in general charge.

Nos. 1-2-3-4 at cathead haul in on cable until raising rope is up.

Nos. 1-2 continue on raising rope and anchor.

No. 3 goes over side to hook mine. When mine is aboard, and automatic anchors are used, he engages hook of raising whip around distance weight rope.

No. 4 assists No. 3 by guiding hook of raising whip to him, both for mine and for distance weight. He is responsible for proper position of mine davit. No. 5 has heaving line ready to pass to D.B. boat if necessary. He catches buoy rope as soon as possible and guides mine to No. 3, and when anchor is on board he removes raising rope.

Nos. 6-7-8 haul cable aft, taking posts about 15 feet apart.

No. 8 comes forward, receives Turk's-head end, and removes heaving line as he walks aft with Turk's-head.

After Deck Detail: N.C.O. in general charge.

Nos. 1-2-3 coil cable in figure eight as it comes to the after deck.

(Note: In coiling cable for replanting, care should be taken that, with Turk's-head pointing forward, the first bight should lead aft on the side on which the mine is being raised. This will insure that, when the coil is lashed and turned upside down, the bights will be ready for paying out properly.)

APPENDIX "F"

MANUAL FOR COAST ARTILLERY CORDAGE

CORDAGE

Ropes are made of hemp, manila, flax, cotton, coir, or other vegetable fiber; or of iron, steel, or other metallic wire.

A yarn is formed by twisting together several fibers of the material used; several yarns or threads are then twisted or spun into a strand; and three or four of these strands twisted together form a rope. The size of a rope is determined by its circumference in inches.

Rope in common use is composed of three strands, laid up right-handed; that is, so that when a strand is followed away from the observer the rotation will be clockwise. Such a rope is said to be laid up *with the sun.*

Cable-laid rope is composed of nine strands. It is made by laying up three ropes of three strands each, right-handed; and then laying these three ropes up into one, left-handed.

A cable is a large rope or chain, and a hawser is a term applied to a large rope smaller than a cable.

Rope is also made of hemp or cotton yarns braided into a rope by machinery to avoid kinking.

Wire rope is made of a certain number of wires twisted into strands and three or more of these strands, usually six, laid up into a rope around a wire or hemp core.

Rope is either tarred or untarred; the latter is more pliable than tarred rope; the former is more durable if the rope is exposed to moisture. Tarring a rope reduces its strength but preserves it from rotting.

The smaller sized cordage is known by sailors as *seizing stuff.* Marline is two stranded, left handed. It is made of finer dressed hemp and has a smoother appearance than spun yarn, which is also left-handed and of two, three, or four strands. Spun yarn is laid up loosely, and, to keep it from opening, is well tarred and rubbed down.

Right-handed rope is coiled *with the sun* (*i.e.*, clockwise). In uncoiling a new hemp rope, pass the end which is at the core through the coil to the opposite side and coil it down against its lay to get the turns out without kinking. Iron and steel wire ropes of large size should be coiled like a figure eight, which enables their being uncoiled without kinking.

The bight of a rope is any part of it not an end, and *a bight* is a loop formed by bending or doubling the rope. The spaces between the strands of a rope are called the *jaws,* and a rope is said to be *long jawed* or *short jawed* as it is loosely or tightly laid up.

The free end of a rope is called the *running* end and the rest of the rope the *standing* part, or end.

Whipping a rope is winding a piece of twine round it near the end to prevent it from unlaying or fraying out. To whip the end of a rope, take a piece of twine of sufficient length, depending upon the size of the rope and the required length of the whipping, and place one end to the right

and the other along the rope to the left. Wind the middle part tightly round the rope and over the two ends of the whipping twine the requisite number of times, and then by pulling on the ends of the twine the whipping is tightened up and completed, after which the ends are cut off. After winding the twine around the rope, the ends may also be secured by sewing them through the rope so that each stitch passes over the whipping and through the jaws of the rope. This is called a *sewed whipping.*

Worming a rope is filling up the jaws of the rope by laying spun yarn or marline along them, to render the surface smooth for parceling and serving.

Parceling a rope is wrapping narrow strips of well-tarred canvas round it, with the lay of the rope, in order to preserve it from injury by water getting in between the parts of the service. Parceling is also used to prevent a rope from being chafed or cut when bearing against a rough surface or a sharp edge. For this purpose it is sufficient to use old rope or canvas.

Serving is the laying on of spun yarn or other small stuff in turns around the rope, close together, and the service is usually drawn tight by means of a serving board, or serving mallet. Small ropes are sometimes served without being wormed when the spaces between the strands are not large enough to make the surface very uneven, but a large rope should always be wormed and parceled before being served. The service is put on *against* the lay of the rope.

Splicing a rope is joining two ends together, or joining an end to any part of it, by interweaving the strands in a regular manner. There are three different splices.

A short splice.—This splice is used in cables, slings, blockstraps and other ropes that are not intended to run through blocks, as the size of the rope is increased at the splice.

To make it, unlay the ends of the two ropes to be joined, for a convenient length. (Whenever a rope is unlaid it should be temporarily seized just above where it is unlaid and the ends of the strands whipped.) Having placed each of the strands of one rope opposite to and in the interval between the corresponding strands of the other, draw them close together. Hold the end of one rope and the three strands which come from the opposite rope fast in the left hand, or if the rope be large tie them down to it with rope yarn. Take the middle free strand and pass it *over* the first strand of the other rope that is next to it, then through *under* the second and out between the second and third from it, then haul it taut. Pass each of the other strands in the same manner; first those of one rope and then those of the other. The same operation may be repeated with each strand, passing each over the third strand from it, *under* the fourth and through; or, as is more usual, after the ends have been stuck once, untwist each strand, divide the yarns, pass one-half of each yarn as above described, and cut off the other half. This tapers the splice. Grease should be well rubbed into the strands when necessary to make them flexible, the strands hauled well through and beaten with a marlinspike or mallet, that the splice may be firm and not draw. When completed the ends of the strands are cut off close to the rope. A tapering pin called a *fid,* if of wood, and a *marlinspike,* if of iron, should be used to open the space between strands sufficiently for the strand to be pulled through in each case. This splice may be made as strong as the rest of the rope.

An eye splice.—The eye splice is used to form an eye or circle in a rope. It is made in a manner similar to that of the short splice. The strands are

untwisted as far as may be judged necessary, and their ends thrust through the corresponding spaces between the three strands in that part of the rope where the splice is to be formed; passing over the second strand they are thrust under the third and so on until the splice is completed the length required.

A long splice.—A long splice is made to join ropes intended to run through a block. Unlay the ends of the two ropes to be joined to a distance three or four times as great as for a short splice and place them together as for a short splice. Unlay one strand for a considerable distance and fill up the interval as it is unlaid with the opposite strand of the other rope, following it up closely. Twist the ends of these two together, then do the same with two more strands, untwisting the strands in the opposite direction on the rope from that of the first. The two remaining strands are twisted together in the place where they were first crossed. Open the two last named strands, divide each in two, make an overhand knot with the opposite halves, and lead the ends *over* the next strand and *under* the second, in the same manner that the strands were passed for the short splice. Trim off the two halves. Do the same with the others that are placed together, dividing, knotting, and passing them in the same manner. Before trimming off any of the half strands, the rope at the splice should be well stretched. Sometimes the whole strands are knotted, then divided, and the half strands passed as above described.

This splice does not increase the diameter of the rope and is therefore used for splicing a fall or rope that runs through blocks or pulleys, but it is weaker at the splice than the rest of the rope.

Seizing.—To seize a rope is to lash two parts of it together, or to lash two ropes together, by means of spun yarn, or what is called *seizing stuff*.

Take a piece of seizing-stuff and double it; pass the bight from right to left under both parts of the rope to be seized, and then pass the ends of the yarns through the bight and haul taut. Separate the ends and pass them around in contrary directions, making fast with a square knot after as many turns have been taken as are necessary. A *round-seizing* is when the seizing-stuff is wound around both ropes without passing between them, while a *racking-seizing* is one in which return of the seizing is passed between the two ropes.

Mousing.—To *mouse* a hook is to seize the point and back of the hook in order to strengthen it and to prevent it from disengaging itself from anything to which it may be hooked. The returns of spun yarn are brought together close to the inside of the point of the hook by two or three turns being taken with the ends in opposite directions around all the returns and secured by a square knot.

An over-hand knot.—This is made by holding a bight or rope in one hand and bringing the short end of bight over same, down, and up through the bight. When drawn up tight this knot becomes a thumb knot, which is made on the end of a rope to prevent its unlaying and is also used as a stopper. The over-hand knot is important because it is the starting point for making many other knots.

Thumb knot.—Made on the end of a rope to prevent its unlaying. Also used as a stopper on the end of a rope to prevent it from slipping through a ring or eye.

Figure eight knot.—This makes a larger stopper than the thumb knot, and does not jam as readily.

Square knot.—Make an overhand knot and pass both ends back through the loop, so that both end and standing part of each rope come out through the loop on the same side. The ends of each rope must be on the same side of their standing parts. If the ends come out on opposite sides of their standing parts a *thief* knot is the result. When the standing part and end of each rope come through the loop on different sides, the *granny* is made. The *square* knot holds tightly, rarely jams in ordinary sized rope, while the thief knot is dangerous, as it looks like a square knot; it will not hold but slips, hence its name. A *granny* knot rarely holds, and, when it does, it jams and is almost impossible to untie.

The bowline knot.—Hold the end of a rope in the right hand with standing part to the left; now lay the end over the standing part, making a loop, and pass the end down through the loop, around and behind the standing part and over and up through the loop, and pull taut. This knot is used to make a temporary eye in the end of a rope. Used to tie a raising rope to a buoy.

The bowline on a bight.—Proceed as for a bowline with the bight in the right and standing part in the left hand; pass the bight through the loop and over the standing part and haul taut. It is valuable in making an eye in the middle of a rope.

Running bowline.—Pass the end of a rope around the standing part and make a bowline knot at the end of the rope on its own part. It is used for making a slip knot.

Anchor knot (or *fisherman's bend*).—Make two round turns around the object to be secured, as a spar, with a half hitch around the standing part and under the turns on the spar and a second half hitch around the standing part. Seize the end. Used to secure a raising rope to an anchor.

Bending ropes together consists in uniting them in such a manner that, while they bite securely, they can be separated more easily than when knotted.

Single bend (or *sheet bend*, called *single becket* in torpedo manual).—Pass the end of a rope up through the bight of the other rope, then under and around both parts of this rope, over the bight of the same and under its own standing part, then tighten the knot. This is used for joining two ropes or a rope to another one at an eye.

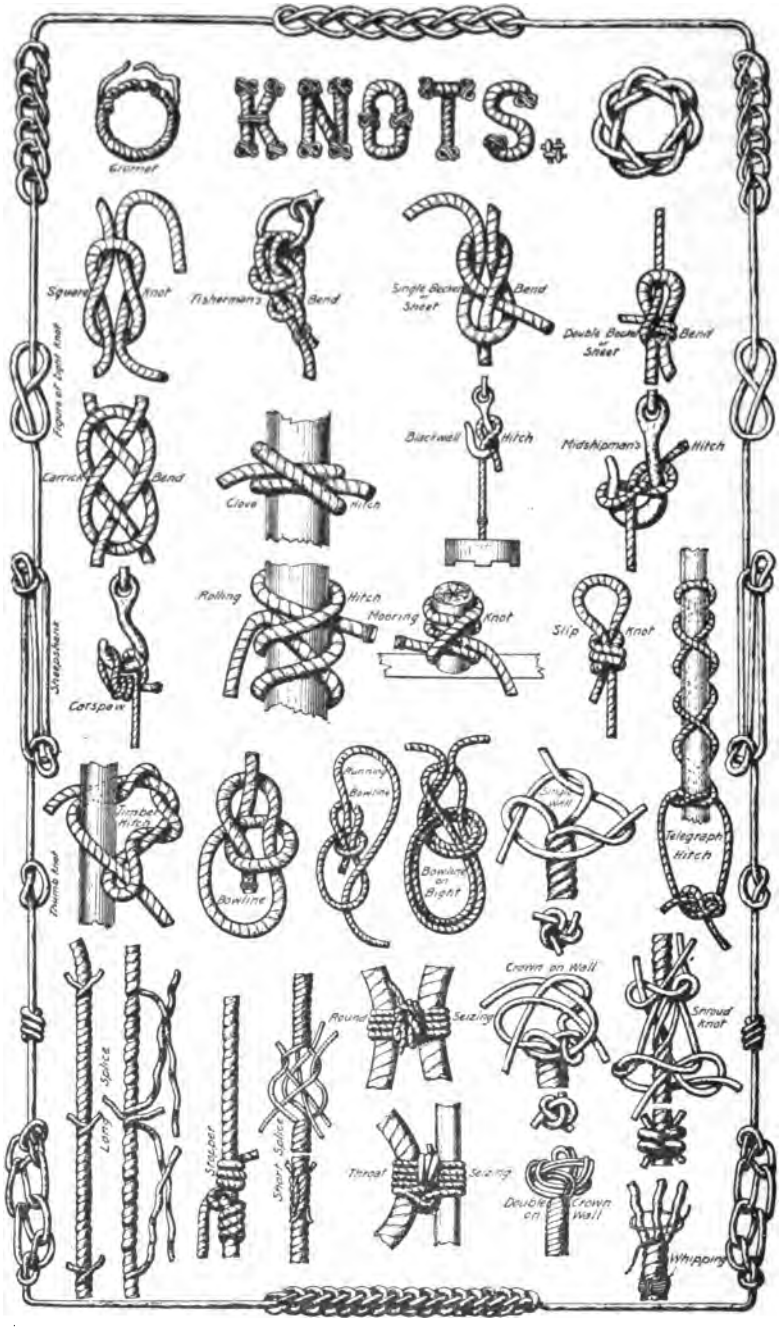
Double sheet bend (or *double becket*).—When additional security is required, or when a small rope is to be bent into a larger one, pass the end a second time around the bight of the rope and bring it again under the standing part.

Carrick bend.—Lay the end of a hawser or chain underneath its standing part, then lay the end of the other rope that is to be secured to it across the bight of the first rope parallel to the underneath end and weave it under this end, over and under, and haul taut. This knot is particularly suitable for joining two chains.

Hitches are used for the purpose of attaching ropes to other ropes, or to spars.

Half-hitch.—This is made by passing the running end of a rope around the rope or spar to which it is to be attached, then around the standing part, and bringing it up through the bight. It may also be seized to the standing part. A safe rule to adopt and apply in all cases where a knot is likely to jam or become untied is to lash the free ends to the standing part.

Two half-hitches.—After making the first half-hitch, make a second in the same manner and seize it, if necessary, as before.


KNOTS.
Grommet
Square Knot
Fisherman's Bend
Single Becket or Sheet Bend
Double Becket or Sheet Bend
Figure of Eight Knot
Carrick Bend
Clove Hitch
Blackwall Hitch
Midshipman's Hitch
Rolling Hitch
Mooring Knot
Slip Knot
Sheepshank
Catspaw
Timber Hitch
Bowline
Running Bowline
Bowline on Bight
Double Wall
Telegraph Hitch
Double Knot
Long Splice
Stopper
Short Splice
Round
Seizing
Crown on Wall
Shroud Knot
Throat
Seizing
Double Crown on Wall
Whipping

Round turn and two half-hitches.—Pass the rope once around what is to be held and then take two half-hitches. When a great strain is to be placed on this knot, it is advisable to stop the end.

Rolling hitch.—Make a hitch with the end of one rope around the second rope; then make another hitch over the first, passing the end under its standing part and around the second rope. Very useful in fastening a tail block to a rope, or in shifting the fall, from end of a windlass, to the other end.

Clove hitch.—Two loops are made, and the right hand one is placed over the left; this double loop is then slipped over the object and drawn up taut. If it is required to pass this hitch around an object over which it would be impracticable to slip the loop, then the running end is passed around the object and brought up on the right side of the standing end, again passed around the object in the same direction on the left of the first turn and brought up under itself; both ends are then hauled taut. This is sometimes used to fasten a small boat to a pile or a heaving line to a cable. When used to bend a heaving line to a cable, one or two half-hitches should be taken around the cable with the free end. As this knot is one of the most useful and frequently required, men should be practiced in making it in various positions.

Mooring knot.—This is a clove hitch with an additional loop in it, used to fasten a mooring rope to a pile.

Stopper hitch.—Make three hitches with line end of a rope around a second rope, and, riding over the first or standing part, reverse direction of winding around standing part and wind around second rope three times in opposite direction. Hold the end of the first rope and secure its standing part to a cleat or ring. It is used to ease part of a rope from a strain, by transferring it to another rope.

Telegraph hitch.—Used to stretch wire, or to handle round, smooth pieces of timber or a spar. It is made by taking two turns with the free end, around the wire or object to be moved, bringing the free end each time under the standing part and then securing the free end, with seizing, along the wire, away from the standing part. The more the strain, the tighter this knot becomes.

Blackwall hitch.—Used for attaching the ends of a rope to a hook when there is a steady pull upon it, as it loosens when the stress is taken off. It is made by putting the end of the rope over the hook and around it and back, so that the end is jammed by the standing part where it crosses it. It is very liable to slip, especially if the rope is small or should become wet. It is also liable to slip when the hook is smooth or very open.

Midshipman's hitch.—Used for the same purpose as the *blackwall,* and is better adapted for it, as it does not slip nor become undone as readily as the latter. It is made the same as a blackwall, except that the end is continued around the front of the hook and then under the standing part.

Cat's-paw.—Also used for attaching a rope to a hook, and is a much more secure fastening. Lay the end of the rope back on the standing part so as to make three lengths parallel to each other. Wind the standing part of the rope a few times around the middle of the parallel parts and then draw the two loops together. Place the loops over a hook. The turns should always be taken or rolled up with the standing part, to prevent the loops from jamming.

Sheepshank.—Used to shorten a rope without cutting it. It can be readily untied. The part of the rope it is intended to shorten is divided into three equal lengths laid parallel to each other; a half hitch is then made

in each of the outer parts, slipped over the end of the loop next to it and drawn taut.

A *strap* is usually made of rope, the ends of which are either spliced or tied together. The strap is passed around the object to be moved, the hook of the tackle being passed through both bights, or through one bight after this has been passed through the other one.

Lashing is the binding, or making fast, of one object to another, by means of ropes. The kind of rope used depends on what is to be lashed and the strains to which it will be subjected.

Blocks and Tackles

A *block* consists of one or more grooved pulleys mounted in a casing or shell, furnished with a hook, eye, or strap, by which it may be attached to a weight, or holdfast; it is used to gain power, or change the direction of a pull by means of a rope or chain passing around the pulleys. Wooden blocks are of two kinds, *made* and *mortised.*

A *made* block consists of four parts: the shell, or outside frame-work; the sheave, or pulley, on which the rope runs; the pin, or axle, on which the sheave turns; and the strap, when there is one, either of rope or iron, which encircles the shell and supports the hook, or eye, of the block.

A *mortised* block is made of a single block of wood, mortised to receive one or more sheaves. Nearly all heavy blocks for artillery purposes are made of an iron or steel shell, with brass sheaves.

A *snatch* block is a single block having an opening in one side just below the sheave to insert the bight of a fall without reeving the end through. The part of the strap which goes over the opening in the shell is hinged so that by turning it back, the bight of the fall can be inserted. Used on a mine planter to change direction of raising rope, or cable, from the cathead to the drum of the winch.

A *tackle* is a rope and block, or a combination of ropes and blocks working together, to aid in lifting or moving objects. It is generally made use of to gain power. That part of the rope of a tackle from the point where it is attached to one of the blocks, to where it passes over the first pulley of the other block is called the *standing* part; the parts of the rope between the blocks, the *running* part; and the part to which the power is applied, the *fall.* The standing part or *end* of a whip is the end of the rope that is attached to the holdfast. To *overhaul* a tackle is to separate the blocks. This should be done from the standing and not from the movable block. To *round in* a tackle is to bring the blocks closer together, which is done by hauling in on the fall.

APPENDIX "G"

U. S. MAGAZINE RIFLE

DESCRIPTION OF THE OPERATION OF THE PRINCIPAL PARTS

Most of the operating parts may be included under the *bolt mechanism* and *magazine mechanism.*

The bolt moves backward and forward and rotates in the well of the receiver; it carries a cartridge, either from the magazine or one placed by hand in front of it, into the chamber and supports its head when fired.

The hook of the extractor engages in the groove of the cartridge case and retains the head of the latter in the countersink of the bolt until the case is ejected.

The safety lock when turned to the left, is inoperative; when turned to the right—*which can only be done when the piece is cocked*—the point of the spindle enters its notch in the bolt and locks the bolt; at the same time its cam forces the cocking piece slightly to the rear, out of contact with the sear, and locks the firing pin.

The bolt mechanism operates as follows: To open the bolt, raise the handle until it comes in contact with the left side of the receiver and pull directly to the rear until the top locking lug strikes the cut off.

To close the bolt, push the handle forward until the extracting cam on the bolt bears on the extracting cam on the receiver, thereby unlocking the sleeve from the bolt, and turn the handle down. As the handle is turned down, the cams of the locking lugs bear against the locking shoulders in the receiver, and the bolt is forced slightly forward into its closed position. The piece is then ready to fire.

To pull the trigger, the finger piece must be drawn to the rear until contact with the receiver is transferred from its bearing to the heel, which gives a creep to the trigger, and then until the sear nose is withdrawn from in front of the cocking piece.

Double loading from the magazine is prevented by the extractor engaging the cartridge case as soon as it rises from the magazine and holding its head against the face of the bolt until ejected.

The piece may be cocked either by raising the bolt handle until it strikes the left side of the receiver and then immediately turning it down, or by pulling the cocking piece directly to the rear.

The opening and closing of the bolt should each be done by one continuous motion.

To charge the magazine, see that the cut-off is turned up showing *on*, draw the bolt fully to the rear, insert the cartridges from a clip, or from the hand, and close the bolt. To charge the magazine from a clip, place either end of a loaded clip in its seat in the receiver and, with the thumb of the right hand, press the cartridges down into the magazine until the top cartridge is caught by the right edge of the receiver. The magazine can be filled, if partially filled, by inserting cartridges one by one.

Pushing the bolt forward, after charging the magazine, ejects the clip.

When the cut-off is turned down, the magazine is *off*. The bolt can not be drawn fully back, and its front end projecting over the rear end of the upper cartridge holds it down in the magazine below the action of the bolt. The magazine mechanism then remains inoperative, and the arm can be used as a single-loader, the cartridges in the magazine being held in reserve. The arm can readily be used as a single-loader with the magazine empty.

When the cut-off is turned up, the magazine is *on;* the bolt can be drawn fully to the rear, permitting the top cartridge to rise high enough to be caught by the bolt in its forward movement. As the bolt is closed, this cartridge is pushed forward into the chamber, being held up during its passage by the pressure of those below. The last one in the magazine is held up by the follower, the rib on which directs it into the chamber.

In magazine fire, after the last cartridge has been fired and the bolt drawn fully to the rear, the follower rises and holds the bolt open to show that the magazine is empty.

Precautions

If it is desired to carry the piece cocked, with a cartridge in the chamber, the bolt mechanism should be secured by turning the safety lock to the right.

Under no circumstances should the firing pin be let down by hand on a cartridge in the chamber.

To obtain positive ejection, and to insure the bolt catching the top cartridge in magazine, when loading from the magazine, the bolt must be drawn fully to the rear in opening it.

When the bolt is closed, or slightly forward, the cut-off may be turned up or down, as desired. When the bolt is in its rearmost position, to pass from loading from the magazine to single loading, it is necessary to force the top cartridge or follower below the reach of the bolt, to push the bolt slightly forward and to turn the cut-off down, showing *off*.

In case of a misfire, it is unsafe to draw back the bolt immediately, as it may be a case of hang-fire. In such cases the piece should be cocked by drawing back the cocking piece.

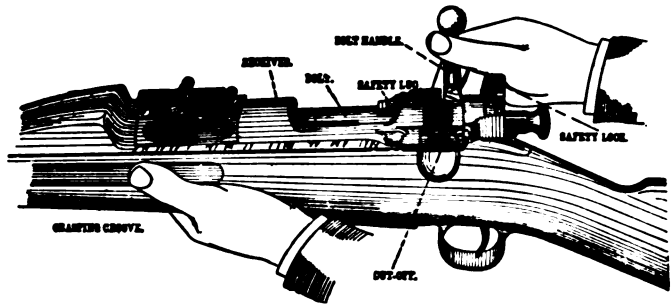
It is essential for the proper working and preservation of all cams that they be kept lubricated.

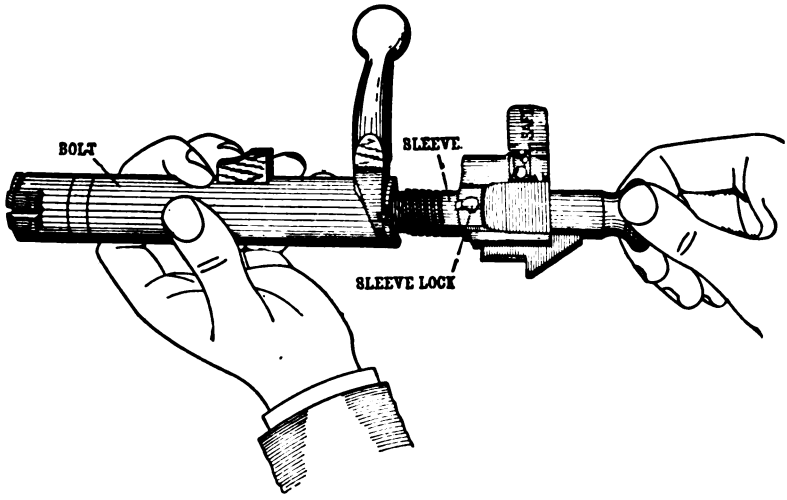
DISMOUNTING AND ASSEMBLING BY SOLDIER

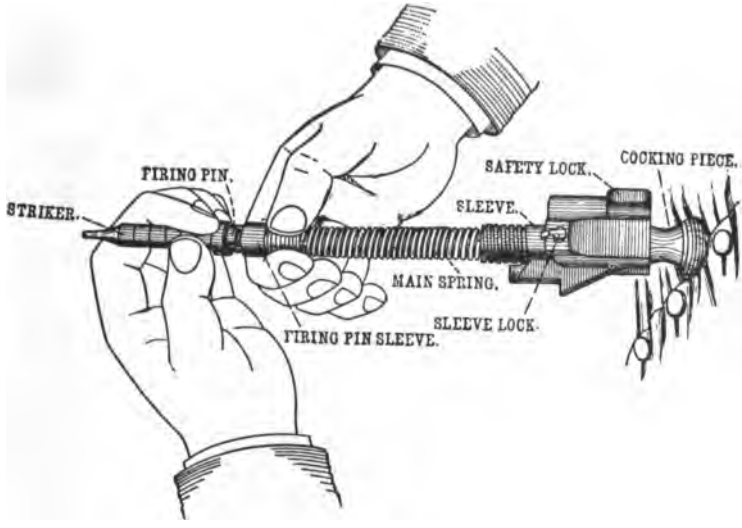
The bolt and magazine mechanism can be dismounted without removing the stock. The latter should never be done, except for making repairs, and then only by some selected and instructed man.

To Dismount Bolt Mechanism

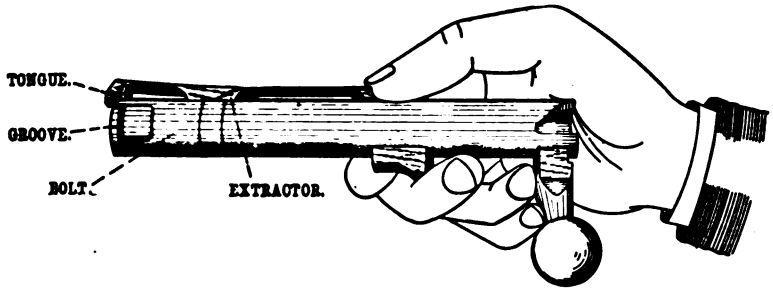
Place the cut-off at the center notch; cock the arm and turn the safety lock to a vertical position, raise the bolt handle and draw out the bolt. Hold bolt in left hand, press sleeve lock in with thumb of right hand to unlock sleeve from bolt, and unscrew sleeve by turning to the left. Hold sleeve between forefinger and thumb of the left hand, draw cocking piece back with middle finger and thumb of right hand, turn safety lock down to the left with forefinger of the right hand, in order to allow the cocking piece to move forward in sleeve, thus partially relieving the tension of mainspring; with the cocking piece against the breast, draw back the firing pin sleeve with fore-


SAFETY LOCK.


BOLT.
SLEEVE.
SLEEVE LOCK

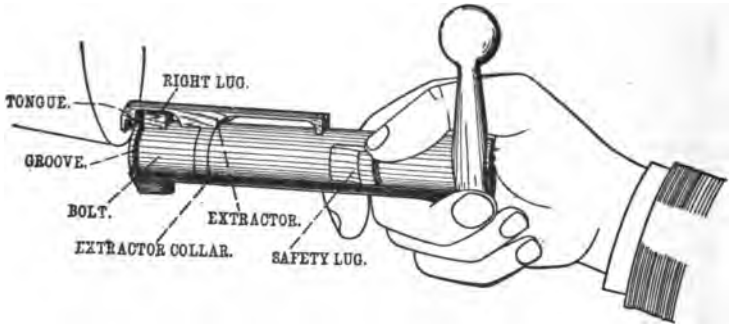

FIRING PIN.
STRIKER.
SAFETY LOCK.
COCKING PIECE.
SLEEVE.
MAIN SPRING.
SLEEVE LOCK.
FIRING PIN SLEEVE.

finger and thumb of right hand and hold it in this position while removing the striker with the left hand; remove firing pin sleeve and mainspring; pull firing pin out of sleeve; turn the extractor to the right, forcing its tongue out of its groove in the front of the bolt, and force the extractor forward and off the bolt.



To Assemble Bolt Mechanism

Grasp with the left hand the rear of the bolt, handle up, and turn the extractor collar with the thumb and forefinger of the right hand until its lug is on a line with the safety lug on the bolt; take the extractor in the right hand and insert the lug on the collar in the undercuts in the extractor by pushing the extractor to the rear until its tongue comes in contact with the rim on the face of the bolt (a slight pressure with the left thumb on the top of the rear part of the extractor assists in this operation); turn the extractor to the right until it is over the right lug; take the bolt in the right hand and



press the hook of the extractor against the butt plate, or some rigid object, until the tongue on the extractor enters its groove in the bolt. With the safety lock turned down to the left to permit the firing pin to enter the sleeve as far as possible, assemble the sleeve and firing pin; place the cocking piece against the breast and put on mainspring, firing pin sleeve, and striker. Hold the cocking piece between the thump and forefinger of the left hand, and by pressing the striker point against some substance, not hard enough to injure it, force the cocking piece back until the safety lock can be turned to the vertical position with the right hand; insert the firing pin in the bolt and screw up the sleeve (by turning it to the right) until the sleeve lock enters its notch on the bolt. See that the cut-off is at the center notch; hold the piece

under floor plate in the fingers of the left hand, thumb extending over the left side of the receiver; take bolt in right hand with safety lock in a vertical position and safety lug up; press rear end of follower down with left thumb and push bolt into the receiver; lower bolt handle; turn safety lock and cut-off down to the left with right hand.

To Dismount Magazine Mechanism

With the bullet end of a cartridge press on the floor plate catch (through the hole in the floor plate), at the same time drawing the bullet to the rear; this releases the floor plate. Raise the rear end of the first limb of the magazine spring high enough to clear the lug on the floor plate and draw it out of its mortise; proceed in the same manner to remove the follower.

To assemble magazine spring and follower to floor plate, reverse operation of dismounting.

Insert the follower and magazine spring in the magazine, place the tenon on the front end of the floor plate in its recess in the magazine, then place the lug on the rear end of the floor plate in its slot in the guard, and press the rear end of the floor plate forward and inward at the same time, forcing the floor plate into its seat in the guard.

CLEANING AND CARE OF THE ARM

As the bore of the rifle is manufactured with great care in order that a high degree of accuracy may be obtained, it should be carefully cared for. The residuum from smokeless powder tends to corrode the bore and should therefore be removed as soon after firing as practicable. The following method has been practiced at the Springfield Armory for a number of years with good results: Using the cleaning rod and small patches of cloth (preferably canton flannel), clean the bore thoroughly with patches soaked in saturated solution of soda and water. Then thoroughly dry the bore and remove the soda solution by the use of dry patches, and finally oil the bore with patches soaked in cosmic oil. Twenty-four hours after this first cleaning, the bore should be again cleaned as described above, as it has been found that the powder gases are probably forced into the texture of the steel and will, if the second cleaning is not resorted to, cause rusting, no matter how thoroughly the bore may have been cleaned at first.

If, however, a cleaning rod is not at hand, the barrel should be cleaned as thoroughly as possible by means of the thong brush and rags, and oiled as above. To clean or oil the bore with rags, the thong brush is unscrewed, the rag placed in the rag slot of the thong tip and drawn from the muzzle toward the breech.

If gas escapes at the base of the cartridge, it will probably enter the well of the bolt through the striker hole. In this case the bolt mechanism must be dismounted and the parts and well of the bolt thoroughly cleaned.

Before assembling the bolt mechanism, the firing pin, the barrel of the sleeve, the body of the striker, the well bolt, and all cams should be lightly oiled.

Many of the parts can generally be cleaned with dry rags. All parts after cleaning should be wiped with an oil rag. The best method of applying oil is to rub with a piece of cotton cloth upon which a few drops of oil have been placed, thereby avoiding the use of an unnecessary amount of oil; this method will, even in the absence of the oiler, serve for the cams

and bearings, which should be kept continually oiled. Any part that may appear to move hard can generally be freed by the use of a little oil.

The stock and hand guard may be coated with raw linseed oil and polished by rubbing with the hand.

Sperm oil only should be used for lubricating metallic bearing and contact surfaces.

For the chamber and bore, only cosmoline or cosmic should be used. This should also be applied to all metallic surfaces, to prevent rusting when arms are stored or when not used for an appreciable length of time.

INSTRUCTIONS FOR CLEANING FROM "SMALL ARMS FIRING MANUAL" (PAR. 134)

After firing, the bore of the rifle is covered with fouling. This is of two kinds, a black deposit covering the entire bore, caused by the burning powder and easily removed with rags, and a metallic fouling, caused by particles of the metal jacket of the bullet adhering to the barrel, which can be removed only by the use of ammonia solution.

The powder fouling must be removed first. Then the metallic fouling can be seen in patches on the lands.

To remove the powder fouling use a cleaning rod long enough to clean from the breech; Hoppe's Powder Solvent No. 9; rags, about 1¼ inches square, of thin flannel or any other soft material.

A cleaning rack should be provided for every barrack.

Rifles should always be cleaned from the breech, thus avoiding any possible injury to the muzzle. Any injury to the rifling at the muzzle will affect the shooting adversely. If the bore for a length of 6 inches at the muzzle is perfect, a minor injury near the chamber will have little effect on the accuracy of the rifle.

The rifle should be cleaned as soon as the firing for the day is completed. The fouling is easier to remove then, and if left longer it will corrode the barrel.

Take a couple of rags soaked in No. 9 and run them through the barrel until they have removed all the powder fouling; run clean rags through to dry the barrel; clean with ammonia solution as directed and finish by wiping out with a greased rag or a clean rag soaked in No. 9. For grease, use vaselin, cosmic, or "3 in 1" oil. After the barrel is cleaned, wipe out the chamber, the cams, bolt, and all visible working parts. Occasionally clean out the magazine and wipe off magazine spring, then wipe all working parts with a greased rag.

After cleaning the working parts, wipe off stock and outside of barrel with oiled rag.

Before firing again, wipe all oil out of barrel, but leave chamber and working parts slightly oily. This will prevent shells binding in chamber and will make parts work easier. Wipe all oil from outside of barrel and stock.

To remove metallic fouling, use ammonia solution. This is made as follows: Take ammonia persulphate, 1 ounce; ammonium carbonate, 200 grains; ammonia (28 per cent), 6 ounces; water, 4 ounces. One rounded tablespoonful equals 1 ounce of persulphate or 200 grains of carbonate.

Powder the persulphate and carbonate separately. Desolve the persulphate in the ammonia and the carbonate in the water and then pour the mixture in a strong bottle, and cork. If mixed in this manner, it may be used in an hour.

To use.—After the barrel has been cleaned with No. 9 and wiped dry, cork up breech with a small cork, put a piece of rubber tubing about an inch long on the muzzle, and fill the barrel with the solution. It will boil up instantly with a white foam, very slightly blue. Let the solution stay in the barrel not more than 10 minutes and then pour out. If there was any metal fouling, the solution will be dark blue.

Fill the barrel with water to remove any remaining ammonia, pour out, and then remove the cork and rubber tube, wipe barrel perfectly dry, and then rub with oiled rag.

Care should be used in mixing and using this solution, for if improperly mixed or used it will injure the rifle. If the solution, after being used, is brown, it is bad and should be thrown away. The proportions of persulphate and carbonate should be the same in bulk. Too much persulphate will injure the barrel.

Keep the barrel filled. If the solution evaporates, it will leave a deposit of persulphate on the surface of the bore and will injure it.

An experienced noncommissioned officer should mix the solution and supervise its use.

Care should be taken not to spill the solution on the barrel or in the mechanism.

APPENDAGES AND ACCESSORIES

The oiler and thong case are carried in the butt of the stock. In one section is carried a small supply of sperm oil, and in the other the thong and brush used for cleaning the bore of the rifle.

The cap on the oil section is fitted with a wire, flattened at its point, which reaches to the bottom of the section and is used for applying oil, a drop or more at a time. *The oil is only for the lubrication of the working parts.* The cap is also provided with a leather washer to prevent leakage. The cap on the thong section has a leather pad on its outer surface, which prevents the noise that would result from the oiler striking the butt plate cap. The oiler should always be inserted in the stock so that the leather-tipped cap will be next to the butt plate cap.

The cleaning rod is made of brass rod 0.25 inch in diameter, and of sufficient length to extend through the barrel.

The front sight cover is made of sheet steel and pressed into shape. It is then case-hardened, giving it sufficient spring to cause it to hug closely the barrel and front sight stud, thereby retaining its position on the barrel. It is used to protect the sight and should be kept in place at all times. During firing, it may be removed, if desired.

The screwdriver has a large blade, a small blade, a spur, a pin, and a rivet. The large blade should be used for the large butt plate screw, the butt plate spring screw, and the guard screws; the small blade for all other screws, except the cut-off screw, for which the spur should be used. The pin serves as a drift in removing the butt plate cap, ejector, floor plate catch, sear and trigger pins, and the lower band spring. No other screwdriver should be used in the repair of the rifle.

AMMUNITION FOR U. S. MAGAZINE RIFLE, MODEL OF 1903

Ball cartridge.—The caliber .30 ball cartridge consists of the case, primer, charge of smokeless powder, and bullet. The case is of cartridge brass. The head of the case is grooved to provide for extraction of cartridge from the

chamber of the rifle. The initials of the place of manufacture, the number of the month, and the year of its fabrication are stamped on the head of case.

The primer consists of the cup, percussion composition, disk of shellacked paper, and anvil. The charge is of composition very similar to the powders used as propelling charges in field and seacoast guns. The normal charge weighs from 47 to 50 grains, varying with the lot of powder used. The bullet has a core of lead and tin composition inclosed in a jacket of cupronickel. It weighs 150 grains, and the point is much sharper and offers less resistance to the air than that of any previous model in the United States service. The standard muzzle velocity of this ammunition in the rifle is 2700 feet per second. The cartridge complete weighs about 395.5 grains, its weight varying slightly with variations in the weight of the powder charge. Five cartridges are packed in a clip. The clip body can be used a number of times, but the springs only once.

The gallery practice and dummy clip is provided with a strong bronze spring without tongues. Sixty ball cartridges in twelve clips are packed in a bandoleer. The bandoleer is made of olive drab cloth and contains six pockets, each holding two clips. The clips can be readily taken out by forcing back the fold of the pocket. The bandoleer is provided with a shoulder strap of olive drab webbing by which it is carried over the shoulder, and a safety pin is provided to afford an adjustment of its length to suit the convenience of the soldier. The bandoleer, with cartridges, weighs about 3.88 pounds.

Blank cartridge.—The *blank* cartridge, model of 1906, differs from the *ball* cartridge in the charge of powder and in the bullet, and in the fact that the case is tinned. The bullet is of paper, hollow, and contains a charge of smokeless powder, which insures the breaking up of the bullet on leaving the bore. A coating of paraffin on the outside of the bullet prevents the absorption of moisture by the paper. Model 1909 has no paper bullet.

Dummy cartridge.—The case of the dummy cartridge is tinned and provided with six longitudinal corrugations, also three circular holes in the corrugated portion. The tinning, corrugations, and holes afford unmistakable means for distinguishing the dummy from the ball cartridge, both by sight and touch. The bullet is the same as in the ball cartridge. The dummy primer has cup and anvil, but no percussion composition.

Guard cartridge.—This cartridge differs from the ball cartridge in the charge of powder and in the fact that second-class bullets having slight imperfections are used. Five grooves encircle the body of the case about the middle (old style), or six short straight grooves encircle it at the shoulder (new style), affording means for distinguishing it from the ball cartridge by either sight or touch. The charge gives a muzzle velocity of 1200 feet per second. This cartridge gives good results at 100 yards and has sufficient accuracy for use at 150 and 200 yards. The range of 100 yards requires a sight elevation of 450 yards, and ranges of 200 and 300 yards require elevations of 650 and 850 yards, respectively.

PARAGRAPH 292, ARMY REGULATIONS, 1913

"Enlisted men will not take their arms apart, except by permission of a commissioned officer under proper supervision, and only in the manner prescribed in the descriptive pamphlet of the arm issued by the Ordnance Department. The polishing of blued or browned parts of small arms, rebluing or rebrowning, putting any portion of an arm in a fire, or removing a receiver

from a barrel, is prohibited. The mutiliation of any part by filing or otherwise, and attempts to beautify or change the finish, are prohibited. Pieces will be unloaded before being taken to quarters or tents, and as soon as the men using them are relieved from duty, unless otherwise ordered. The use of tompions in small arms is forbidden. The prohibition in this paragraph of attempts to beautify or change the finish of arms in the hands of enlisted men is not construed as forbidding the application of raw linseed oil to the wood parts of the arms. This oil is considered necessary for the preservation of the wood, and it may be used for such polishing as can be given by rubbing in one or more coats when necessary. The use of raw linseed oil only will be allowed for re-dressing, and the application for such purpose of any kind of wax or varnish, including heelball, is strictly prohibited."

APPENDIX "H"

GEOMETRICAL MAGNITUDES AND AZIMUTH INSTRUMENT

Geometrical Magnitudes

A *point* is that which has neither length, breadth, nor thickness, only position.

A *line* is that which has length, without breadth or thickness. The word *line*, when used alone, designates a straight line; that is to say, a line that does not change direction at any point.

A *curve*, or curved line, is a line that changes direction at every point.

A *surface* is that which has length and breadth without any thickness.

A *plane* is a surface such that if any two of its points be taken, the straight line which joins them will lie wholly in the surface.

A *circle* is a plane figure bounded by a curve (called a *circumference*), every point of which is equally distant from a point within, called the *center*. A circumference is frequently called a *circle*. Any line passing through the center and terminating at both ends in the circumference is called a *diameter*. Any line extending from the center to the circumference is called a *radius;* it is one-half the diameter. Any part of the circumference is called an *arc*.

A circumference is supposed to be divided into 360 equal parts, each of which is known as a *degree;* and each degree of a horizontal circle is divided into 100 equal parts, called *hundredths;* while each degree of a vertical circle is divided into 60 equal parts, each of which is known as a *minute*.

An *angle* is the difference in direction between two lines that meet, or would meet, if sufficiently prolonged. A shorter definition is: An *angle* is the divergence of two intersecting lines. These lines are the sides of the angle, and the point where the two sides meet is called the *vertex*. The arc of a circumference included between the sides of the angle and having its center at their meeting point (vertex) is a measurement of the angle.

When two lines so intersect each other as to form four equal angles, such lines are said to be *perpendicular* to each other. Each angle in this case is measured by an arc of one-fourth of the circumference (90 degrees), such arc being known as a *quadrant*.

An angle of more than 90 degrees is known as an *obtuse angle*.

An angle of 90 degrees is known as a *right angle*.

An angle of less than 90 degrees is known as an *acute angle*.

The circumference of any circle is 3.1416 times the length of its diameter. Planes or lines which are everywhere the same distance apart are said to be parallel with each other.

If a *plummet* be freely suspended by a line and allowed to come to a state of rest, the line has a direction through the center of the earth, and is said to be vertical, or plumb.

A *horizontal*, or *level*, *line* is a line upon which, if a carpenter's level be placed, the bubble will be in the center.

A *vertical plane* is any plane passing through a vertical line, or plummet line.

A *vertical angle* is an angle whose sides lie in a plane of a plummet (*i.e.*, a vertical plane).

A *horizontal plane* is any plane such that, if a carpenter's level be placed on it in any position, the bubble will be centered.

A *horizontal angle* is an angle whose sides lie in a horizontal plane.

Vertical angles and horizontal angles are those used in gunnery. For range finding purposes, using the horizontal base system, only horizontal angles will be considered. These angles are called *azimuth angles*, or *azimuths*, when they are included between the true north-and-south line (meridian) drawn through the observer's station (the vertical axis of the instrument), and the line through the station to the object, and measured from zero degrees at the south towards the west (clockwise direction), to the line to the object. An instrument is said to be set up in azimuth, or oriented, if it reads zero when its telescope points south. The azimuth of the south is 0 degrees (or 360 degrees); of the west, 90 degrees; of the north, 180 degrees; of the east, 270 degrees.

The Azimuth Instrument

The azimuth instrument is a device for measuring horizontal angles. In order to measure horizontal angles, it is necessary that the instrument be rotated in a horizontal plane. This is accomplished by making the instrument's graduated circle level, *i.e.*, horizontal, by means of two levels at right angles to each other. The axis of the telescope is the center line of the telescope. The vertical axis of the instrument is the vertical line passing through the center of the instrument. This is perpendicular to the axis of the trunnion of the telescope when the instrument is level. The smallest reading on the graduated circle is one degree, and the smallest reading on the index disc is one one-hundredth of a degree.

Instructions for the Manipulation of the Instrument

When the worm-box eccentric crank is turned away from the operator, the worm on the worm-shaft is thrown in gear, *i.e.*, meshes with the worm gear. This releases the worm-box spring, which, in turn, presses the worm-box and the worm-screw against the worm-gear on the graduated circle. The worm is thrown out of gear by turning the eccentric crank toward the operator. This presses the worm-box against the worm-spring, and that one against the back part of the shield. The screw in the shield near the eccentric crank is the worm-box adjusting screw. The screw on the worm-shaft, longitudinally through the index disc, is the worm adjusting screw.

When the worm is thrown in gear and the index disc is turned, be sure that a distinct click is heard; this indicates that the worm-screw has properly meshed with the teeth, or cogs, of the worm-gear. Remember to have the worm-screw thrown in gear before the azimuth clamp is opened. The only time the slow-motion screw will be used is when the instrument is oriented and a fine setting in azimuth is required. When the slow-motion screw is used, the worm-screw must be in gear and the azimuth clamp tightened, else the slow-motion screw will not operate. The Warner and Swasey Azimuth Instrument (Model 1900) has a power of six and a field of four degrees. If the instrument will not stay level after the usual operation of leveling, the spirit level holders are out of level, and the levels are adjusted as follows:

Set one level parallel with two opposite leveling screws and bring the bubble to the center. Reverse the telescope through 180 degrees. If the

bubble is not in the center, the level is out of adjustment. Now correct one-half of the error by using the small steel pin on the little adjusting screws referred to above. Now turn the telescope 180 degrees again. If it is still out of level, continue the above method of correction until, on reversing the telescope, no change in the motion of the bubble can be observed.

When through using the instrument, put on the sunshade cap, clamp the telescope trunnion screws (the telescope being horizontal), determine the proper position in azimuth for the telescope in its seat in the box and clamp in that position. Tighten all the clamp screws. Carefully unscrew and remove the instrument from the tripod and lower it carefully into the box, observing the same precautions as in removing it from the box. Do not touch the telescope after it is clamped, and do not drop the instrument into the box with a jar.

APPENDIX "I"

STORAGE AND CARE OF EXPLOSIVES

MANUFACTURE OF GUNCOTTON PRIMERS FOR SUBMARINE MINES AT POSTS

CUTTING GUNCOTTON PRIMERS

With service charges of guncotton, the requisite number of primer cakes will ordinarily be supplied. These cakes are cylindrical, 3.5 inches in diameter, 2 inches thick with a central 9/16 inch cylindrical perforation piercing the plane faces of the cake. Should the supply of these primers become exhausted, serviceable primers may be prepared from the 2.9" x 2.9" x 2" cake used in the charge as follows: Two blocks of soft pine about 1 inch thick are used, one 3 inches square, and the other circular and 2.9 inches in diameter. A cake of *wet* guncotton is clamped between the blocks, the square block underneath. Using a fine joiner's saw, with the circular block as a gauge, a cylinder is sawed from the cake and finished with a rasp. Just a sufficient amount should be removed to permit the cake to be slipped into the rubber fuse can. A 9/16 inch hole is then bored through the cake. When the cake is being sawed and the hole bored, the cake must be tightly clamped between the soft pine boards, otherwise it will split. Four cakes are prepared in this manner for each fuse can. The boring is done with an ordinary bit, which must be sharp so as to cut clean. *It is not safe to bore or saw a dry guncotton cake.*

DRYING GUNCOTTON PRIMERS

Wet guncotton primers may be dried by either of the following methods:

(1) Exposure in a drying oven.

(2) Exposure in a dry atmosphere.

(1) *Drying in an oven.*—The cakes are laid out on the shelves and the temperature of the oven is kept at about 100° F., and should never exceed 104° F. The heat is provided by means of a bank of lamps placed under the hood and the current of warm air regulated by the size of the lamp bank and the openings in the top of the oven. Under no circumstances must an open flame be used as a source of heat. The drying should continue until successive weighings of a sample show no appreciable loss.

(2) *Drying by exposure in a dry atmosphere.*—The blocks to be dried are carefully weighed separately, and the weight of each marked on the block with a soft lead pencil. The weights are then recorded in a memorandum book. Place the blocks on a support made of wire netting, separating the blocks from each other to expose all surfaces freely to the air. Suspend the shelf in some suitable place, where the blocks will be freely exposed to the air, and be under cover. Keep out of the direct rays of the sun. Expose the blocks only when the atmosphere is dry, at all other times keep them hermetically sealed in a suitable receptacle. An empty guncotton box will do very well for the purpose. Weigh each block after twenty-four hours' exposure and continue drying until each block shows no loss of weight

for two consecutive days, the weather being moderately dry. This may require a week or more.

When primers have been dried they should be kept in well sealed jars, unless they are to be used very soon after drying, in which case they could be stored in assembled fuse cans.

To test the dryness of primers, take a cake and split in four or five pieces and detonate each separately with a fuse.

General Instructions

(Numbers refer to paragraphs in the 1914 Drill Regulations.)

479. All dirt, grit, and foreign material will be removed from cases before placing them in storage. In handling cases containing explosives, they will be raised, carried to the new position, and gently lowered. Rolling, sliding, or dropping cases must be avoided.

480. One of the most important requirements in the care of any explosive is absolute cleanliness in and about the place where the explosive is stored. By removing all foreign materials from a magazine, the chances of accidents are reduced. The ground around the storage place will be kept free from leaves, long grass, brush, débris, or anything which may increase the fire risks.

481. Officers charged with the receipt and storage of explosives will direct personally the work of handling the cases.

482. Cases will never be exposed to the direct rays of the sun longer than is absolutely necessary. They will be covered with a paulin or similar cover in such a way as to admit of the free circulation of air. The effect of the direct rays of the sun on a metallic case is to raise the temperature inside the case to a point considerably above that of the open air, and this temperature is maintained for a considerable time after the exposure.

483. In opening cases, implements which may produce sparks will not be used. Suitable implements are a wooden mallet, or a copper hammer with a wooden wedge or copper chisel. A hammer will be used only when necessary, and then as lightly as possible.

484. The keys of magazines and storage places will be kept in the hands of thoroughly reliable and responsible persons.

485. Whenever there is more than one kind of explosive in a storage place, but one kind will be placed in a pile, and the different kinds separated as much as possible.

486. The date of the receipt of any explosive at a fort will be marked on the outside of the container. Each separate package will be marked.

487. Only those explosives mentioned herein as being suitable for storage together will be placed in any single storage place.

488. Free circulation of dry air is most desirable in any place where explosives are stored. Cases will always be raised off the floor of the storage place and placed on skids.

489. If a storage place is artificially heated, or from climatic conditions the temperature of the air is liable to rise above 85° F., a maximum thermometer will be suspended therein, the temperature will be watched carefully during the period of excessive heat, and the daily readings will be recorded on the proper Ordnance Department form. Should a temperature as high as 100° F. be maintained for any length of time, the place will be cooled or the explosive removed.

491. Matches and unauthorized lights will not be permitted in any magazine.

492. No loose explosive will be permitted in any building, except such as is being used actually in preparing charges.

Commercial Detonators

PACKAGE

495. These detonators are supplied in pasteboard boxes containing 50 each, and the pasteboard boxes are shipped in suitable wooden containers.

STORAGE AND CARE

496. Commercial detonators may be stored in any place which is available, provided it is cool, dry, secure from entrance by unauthorized persons, and not subjected to temperatures greater than 100° F.

497. Under no circumstances will detonators be stored with other explosives, except fuses and primers, and temporarily with dry guncotton when in the fuse cans preparatory to loading mines. (See dry guncotton.)

498. On account of the sensitiveness of mercury fulminate, the filling charge of the detonator, to detonation, special care will be exercised in keeping individual detonators off the floor or other places where they may be exploded by stepping on them or dropping heavy articles on them.

499. Detonators will never be handled by the wires in such a way that the detonator itself may be brought in violent contact with any object.

INSPECTION

500. The inspection of this class of explosives will be limited to seeing that the requirements of storage and care are observed strictly.

Dynamite

PACKAGE

501. Dynamite cartridges are packed ordinarily in sawdust in wooden boxes. Each cartridge is wrapped in paraffin paper. The cartridges are arranged in the box so that when they are transported all cartridges lie on their sides. Usually the amount of explosive in a single package does not exceed 50 pounds.

STORAGE AND CARE

502. The boxes will never be allowed to stand so that the cartridges will be vertical.

503. Like other nitroglycerin mixtures, dynamite freezes at about 40° F., and in its frozen condition is, under ordinary circumstances, less liable to explosion from detonation or percussion than when thawed, but more susceptible to explosion by simple ignition. Should any of the nitroglycerin be exuded, the dynamite cartridges are much more sensitive to detonation by a blow.

504. It is important that dynamite cartridges be kept dry. If exposed to a moist atmosphere, there is a tendency for the water, condensed from the air on all exposed surfaces, to displace the nitroglycerin.

505. The cases will be raised from the floor on skids, and the floor underneath covered with clean sawdust. The sawdust will be removed from time to time, the old sawdust being burned in the open air.

506. Rubber gloves will be worn in handling this explosive. In the absence of rubber gloves, the hands should be covered with grease and cotton gloves should be worn. This is for the protection of the skin from the injurious effect of nitroglycerin.

507. Dynamite may be stored with wet guncotton (15 per cent water based on dry weight of explosive), Explosive D, and trotol, but preferably should be stored by itself.

INSPECTION

508. At the monthly inspection, all boxes will be examined to see if they are dry. If not dry, all will be exposed to the dry air out of the direct rays of the sun, but great care will be taken in handling these boxes to avoid dropping them or subjecting them to shock.

509. The principal source of danger from dynamite is in the exudation of the nitroglycerin. Exudation is indicated by the presence of small white, oily, lustrous globules of liquid, either among the particles of dynamite or on the packages. If such globules are discovered, they may be identified positively as nitroglycerin by absorbing a drop in a piece of unglazed paper, placing it on an anvil or other piece of metal, and striking it a sharp blow with a hammer. If it be nitroglycerin, detonation will occur. Another test is to set fire to the paper, and if the liquid be nitroglycerin, it will burn with a crackling noise and a greenish-yellow flame.

510. If exuded nitroglycerin has stained floors or other material not readily destroyed, the nitroglycerin may be decomposed and rendered harmless by washing with sulphur solution. Sulphur solution may be made by boiling 50 pounds of lime in a barrel of water and adding powdered sulphur until the solution will take up no more. This requires about 20 pounds of sulphur. The resulting bright orange-colored solution is filtered and only the filtrate used. A suitable filter for this purpose is a piece of thin cheese cloth. Sodium carbonate may be used in the place of lime.

511. Dynamite may be destroyed by burning in small quantities at a time. The cartridges are slit with a knife and the contents are spread out over some straw or shavings, and ignited carefully. If the dynamite is frozen it will not be burned.

FUSES AND PRIMERS

PACKAGE

523. Fuses and primers are packed in hermetically sealed metallic boxes, inclosed in suitable wooden containers. These boxes will not be opened until the fuses and primers are required for use.

STORAGE AND CARE

524. Cases of fuses and primers may be stored in any place which is available, provided it is cool, dry, secure from entrance by unauthorized persons, and not subjected to a temperature greater than 100° F.

525. All boxes containing fuses will be marked with metal labels, obtained from the Ordnance Department, clearly indicating the projectiles to which the fuses are assigned.

526. Under no circumstances will fuses and primers be stored with other explosives except the commercial detonators used in submarine mines.

527. Fuses will not be disassembled for any purpose. Such action by inexperienced persons is liable to result in explosion.

INSPECTION

528. The inspection of this class of explosives will be limited to seeing that the requirements of *storage* and *care* are observed strictly.

GUNCOTTON

PACKAGE

529. Wet guncotton for submarine mines is supplied in boxes containing approximately 100 pounds of dry guncotton with 25 pounds of water absorbed; total weight, 125 pounds. For storage this is dried down to 15 pounds of water to 100 pounds of dry guncotton. The boxes are lined with zinc and the lids are screwed down upon a rubber gasket. There is an opening in the lid for replacing water lost by evaporation. The manufacturer's name, the date of nitration, net and gross weights are stamped on each box. The object of having the gross weight on the box is to give an easy means of checking the amount of water contained in the guncotton at the time of the quarterly weighing.

STORAGE AND CARE

530. Magazines in which guncotton is stored will not be allowed to attain a temperature as high as 100° F. for any length of time.

531. Guncotton which is *kept wet* may deteriorate after long storage, but will not become dangerous.

532. Wet guncotton can not be ignited by a flame, but gradually smoulders away as the outer portions in contact with the flame become dried.

533. A brownish or reddish shade is sometimes seen in cakes of guncotton. This may be due to the presence of iron in the wash-water and does not necessarily indicate decomposition.

534. When storing guncotton in the magazine, the piles of boxes will be made so as to give free circulation of air and the greatest convenience in handling consistent with the capacity of the magazine.

535. In the event of damage to any case, which may cause loss of water by evaporation, the contents will be removed at once, repacked in a guncotton box which has been washed with soda solution, the proper amount of water added to the contents, and the box closed. The gross weight will be marked on the case. In repacking, the cakes will not be handled with the bare hands. This is for the protection of the guncotton from oil or acid of any kind. Clean cotton or rubber gloves are suitable covering or the hands when engaged on this work.

536. If for any reason the cases are subjected to dampness sufficient to cause unusual deterioration of the cases, they will be removed from the magazine and dried out of the direct rays of the sun.

537. Guncotton containing 15 per cent of moisture (percentage based on dry weight of explosive) may be stored with explosive "D," dynamite or trotol, but *never with dry guncotton.*

538. Empty cases, before being placed in storage, will be washed thoroughly to remove all traces of guncotton.

INSPECTION AT POSTS

540. In addition to the regular monthly inspection, at the end of each quarter the officer responsible for submarine-mine explosive will supervise the weighing of each box of guncotton under his care. Any loss in the gross

weight will be made up by the addition of distilled water poured through the filling hole. If there is no distilled water available, rain water should be used. Water thus added will be absorbed gradually by the charge. No further inspection of this explosive is necessary.

Dry Guncotton

541. Dry guncotton is used for submarine mine primers.

542. Primers will not be prepared until just prior to the time they are to be used in loading. Therefore the period of storage will be short and no particular examination of the dry guncotton will be required.

543. Dry guncotton, during the interval between loading in the mine case and the time the dryness is secured, will be stored ordinarily in an assembled fuse can. When prepared in this manner it will be kept in a cool, dry, and secure room away from all other explosives.

544. Dry guncotton will be handled as little as possible to prevent crumbling and scattering of guncotton dust. Finely divided guncotton is difficult to remove by brushing, and if allowed to collect about a room may give serious trouble by "flashing," should a portion become ignited. This dust may be removed with a damp sponge or cloth.

545. Dry guncotton which is not used as contemplated (par. 543) will be repacked with the proper amount of water.

Trotol

PACKAGE

546. This explosive is trinitrotoluol. It is used in the service as an explosive charge for submarine mines, and is supplied in wooden boxes, doubly lined with waxed paper, each box containing about 50 pounds of explosive.

STORAGE AND CARE

547. This explosive will be stored in a perfectly dry place, perferably in a magazine. If it is impracticable to store it in a magazine, the explosive will be stored in the driest place available where it is protected thoroughly from all fire risks.

548. The boxes will be stored in tiers with the marked end out, the bottom tier resting on skids.

549. If from any cause the boxes of explosive are wet and there is reasonable assurance that the interior has become wet, a box will be selected and opened. If the interior is wet, a full report on the circumstances will be made to the War Department. The boxes will be opened and the contents dried in open air, out of the direct rays of the sun.

550. Trotol may be stored with wet guncotton (15 per cent water based on dry weight of the explosive), explosive "D," and dynamite.

INSPECTION

551. Inspection at forts will be limited to seeing that the rules for storage and care are strictly observed.

552. Technical inspections will be made when required by the Ordnance Department.

APPENDIX "J"

CARE OF MATERIEL

(Numbers refer to paragraphs in the 1914 Drill Regulations.)

412. Coast defense structures, and the grounds surrounding them whose limits are prescribed by fort commanders, will be kept in proper police.

413. All open drains or gutters will be carefully swept at least once a week, and the sweepings so disposed of that they will not be carried back by wind and water.

423. *Oils* (see Ordnance Pamphlet No. 1869).—The important oils and lubricants supplied and uses therefor are shown in the following table:

Name	Use
Hydrolene	For filling recoil cylinders.
Kerosene	For cleaning purposes only, especially recoil cylinders.
Light slushing	For the bore, and for the bright parts of guns and carriages, when they are to remain unused for a considerable time.
Engine	For bright parts of guns and carriages when in daily use. For lubricating purposes where oil holes or plugs are provided.
No. 4½ Lubricant	For filling grease cups of heavy bearings.
Turpentine	For thinning paint.
Clock	For bearings of sights, position finders, etc.
Graphite	For use on heavy bearings in connection with 4½ lubricant, proportion 5% graphite to 95% lubricant *by volume*. Also for use on gas-check pads, proportion 50% graphite and 50% lubricant *by weight*.

Oils will be kept in closed receptacles, free from contamination, and will not be used a second time unless strained carefully. Discoloration does not in itself affect the serviceability of oils.

425. *Painting guns and mortars.*—In general, three coats of paint will be given guns and mortars the first year that they are mounted; thereafter one or two coats annually will suffice, the actual needs depending upon the climate and local conditions.

As soon as the piece is mounted on its carriage, all parts which have been marred in transportation will be primed, after which one complete coat of the gray paint will be applied.

The entire external surfaces of guns and mortars, except oil holes in breech plates and except the portions where the tray or block-carrier bears, will be painted gray. When detached quadrants are used with mortars, the seats for the quadrants will be left unpainted. Before painting, the surfaces will be rubbed smooth and made perfectly *clean* and *dry*. Special care will be exercised to prevent painting contact surfaces forming part of

an electrical circuit. Cross lines on muzzle and breech faces should be free from paint. Grooves in the breech face should not be painted.

Bronze trays will not be painted. Steel trays, excepting the upper and front surfaces and guide rails, will be painted the same color as the gun. No parts of the breechblock or mechanism will be painted. The unpainted surfaces will be kept clean and bright with oil or pomade.

The elevating bands of pieces mounted on disappearing carriages and the elevating racks attached to pieces mounted on mortar and barbette carriages will be painted the same color as the guns or mortars, leaving the bearing surfaces of the teeth unpainted.

426. *Painting carriages.*—The number of coats of paint required for carriages is the same as that for guns and mortars. Before painting, surfaces will be rubbed smooth and made perfectly clean and dry. As soon as the carriage is assembled completely and the piece mounted, all parts which have been marred in transportation will be primed, after which one complete coat of olive green paint will be applied. In applying this paint the utmost care will be taken to avoid interference of proper functioning of moving parts, and also to avoid getting paint into oil holes or bearings.

All steel and iron nonbearing surfaces, both inside and out, will be painted. This includes the exposed parts of shafts (except squared ends), bottom plate of counterweight, ladders, springs, crossheads, cranks (not handles), crosshead pawls (except teeth), and large bronze pieces, including web and spokes of wheels and cylinder heads.

The following parts will not be painted: All wearing or bearing surfaces, which include the handles of handwheels and cranks, teeth of all gear wheels, teeth of crosshead pawls and safety latches, teeth of crossheads, elevating-rack guides, rollers and surfaces on which they travel, piston rods, crosshead guides, etc.

Bronze sight holders will not be painted, nor will azimuth and elevation scales and pointers, nor followers of stuffing boxes; these parts, with the exception of sight holders, will be kept clean and bright with oil or pomade. Scales should be clean but not polished, as the reflected light is liable to interfere with reading the scale.

Name and direction plates for carriages, and trunnion brackets for telescopic sights will not be removed. Name and direction plates will be painted, but the raised surfaces of the letters and figures will be kept polished. Trunnion brackets will not be painted.

427. The paints mentioned are supplied in original packages, mixed ready for use. In all cases before using, the contents of the package will be stirred thoroughly with a wooden paddle; if thinning is desired, turpentine or other authorized liquid will be used. Care will be exercised to have the paint of the proper consistency before it is applied.

428. *To remove old paint from guns and carriages.*—When the paint becomes so thick as to scale off in places or to give an unsightly appearance, as is the case after a number of coats have been applied to guns and carriages, it will be removed for repainting as follows:

Dissolve one pound of concentrated lye, powdered form, in 6 pints of hot water and add enough lime to give the solution the consistency of paint. Apply this solution, freshly mixed, to the parts where paint is to be removed with a brush or with waste tied on the end of a stick. When the solution begins to dry on the surface, use a scraper to remove the old paint and complete the cleaning of the surface with a mop and water. If one applica-

tion is not sufficient to loosen the paint, apply a second coat. Before applying a new coat of paint, wash the surface with a solution made by dissolving one-half pound of washing or sal-soda in 8 quarts of water and wipe as dry as possible. Let stand a sufficient length of time so that all parts will be thoroughly dry before painting.

437. *Care of guns.*—No part of the piece will be allowed to rust at any time, and if it is to remain unused for considerable intervals all bright and bearing parts will be covered with a coat of light slushing oil. For the bore, two applications per year are considered sufficient; for surfaces exposed to the weather four applications may be required.

440. After firing, the powder residue will be removed by using the sponges well saturated with water. The sponges will be covered with sufficient burlap to make them a snug fit and insure reaching the bottoms of the rifling grooves. Flushing the bore with a hose immediately after firing facilitates cleaning.

443. *Care of carriages.*—When in use, all bearing parts will be cleaned and lubricated thoroughly. In all carriages special attention will be given to the lubrication of gun trunnions, rollers, pintle surfaces, sliding surfaces, elevating, loading, and traversing mechanisms, including the teeth of all gears. On disappearing carriages, the following parts will be lubricated also: gun-lever axle bearings, crosshead pins, tripping and retracting mechanisms, elevating rack and band trunnions, and crosshead guides.

Oil holes where provided will be cleaned out frequently to keep them free from sand and grit, and kept closed habitually by the screw plugs or covers provided, except during oiling.

Before oiling at any oil hole, wipe off carefully any dirt or grit near the opening that might be carried down into the bearing by the oil.

444. Compression grease cups will be filled with No. 4½ lubricant. The caps will then be screwed down on the cup until the spring rod projects about 0.25 inches above the top of the cap. This adjustment should be made from day to day, as required to maintain about this projection for the rod.

445. Care will be exercised that no water is allowed to enter the recoil cylinders when they are filled with oil or at any other time, for this will cause rusting of the interior of the cylinders, and in cold weather it may freeze and burst the equalizing pipes or other parts of the recoil system.

446. Experience has indicated that the oil should not be removed from recoil cylinders when carriages are to remain unused for a considerable period, as the walls of the cylinders soon become dry and rust. For this reason, any leakage will be promptly replaced.

449. If rust is allowed to accumulate on carriages, its removal from all bearing parts, especially piston rods and teeth of gears and racks, requires particular attention in order that clearances may not be increased unduly. Emery cloth No. 1 is coarse enough for removal of ordinary rust, the rust being softened, if necessary, by kerosene. *The use of sandpaper for this purpose is forbidden.*

467. *Care of telescopes.*—The prisms and lenses in the telescopes of position finders, azimuth instruments, and sights are not arranged for adjustment by those using them; the taking apart of telescopes for any purpose, and the making of any adjustments other than those provided for in their construction and described in Ordnance pamphlets (1795 and those

describing sight or instrument to which the telescope pertains), except under the supervision of district armament officers, are forbidden.

When telescopes or any instruments of the range-finding and fire-control system for coast artillery issued by the Ordnance Department require repair, a report describing the character and extent of the injuries or defects will be made to the armament officer of the district. In case the repairs or adjustments required by telescopes and other delicate instruments of precision are of such a nature that they cannot be made at the fort, the instruments will be shipped by express to such arsenal as may be designated by the district armament officer. Since exposure to moisture and dust results in serious injury to lenses of optical instruments, covers will be kept on, except when the instruments are in use.

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